Regional Operational Plan CF.4K.2015.02

Alaska Peninsula Salmon Enumeration and Escapement Sampling Procedures, 2015–2016

by

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and

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March 2015

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

REGIONAL OPERATIONAL PLAN CF.4K.2015.02

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by

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Division of Commercial Fisheries

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SIGNATURE PAGE

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Title	Name	Signature	Date
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PURPOSE

In the Alaska Peninsula Management Area (Area M), weirs are a primary mode of enumeration for sockeye salmon *Oncorhynchus nerka* escapements into some area streams. Annually, the Alaska Department of Fish and Game (ADF&G) samples adult sockeye salmon escapements from Nelson, Bear, Sandy, and Ilnik rivers, and Orzinski Lake weirs for age, sex, and length (ASL) data. Out-migrating juvenile sockeye salmon (smolt) are also sampled for age, weight, and length (AWL) at Bear River and Orzinski Lake weirs. The biological information collected from escapements, combined with catch sampling information, provide the foundation for preseason run forecasts, escapement goal evaluation, and accurate assignment of the run to stock of origin (run reconstruction) to some North Peninsula systems. This data assists with long-term management of sockeye salmon stocks while daily monitoring of the sockeye salmon escapements helps ensure that escapement goals are met. Operation guidelines for the five Alaska Peninsula ADF&G weir camps are presented, including weir installation instructions, salmon enumeration and sampling procedures, and general camp policies.

Key words: Alaska Peninsula, Area M, commercial salmon harvest, escapement, sampling, weir, operational plan, Chinook salmon, *Oncorhynchus tshawytscha*, sockeye salmon, *Oncorhynchus nerka*, coho salmon, *Oncorhynchus kisutch*, pink salmon, *Oncorhynchus gorbuscha*, chum salmon, *Oncorhynchus keta*.

BACKGROUND

The basic function of fisheries management is to ensure sufficient spawning escapement while allowing the harvest of available surpluses, consistent with the maximum sustainable yield principle and subject to allocations established through public regulatory processes. Annually, the Alaska Department of Fish and Game (ADF&G) crews enumerate and sample escapements at 5 weirs on the Alaska Peninsula; Bear, Nelson, Sandy, and Ilnik rivers, and Orzinski Lake (Figure 1). Sockeye salmon smolt samples are also collected weekly at Bear River and Orzinski Lake, serving as indices of outmigration, age composition, and smolt condition. A brief description and history of each weir site is provided in this document. Guidelines for installation of each weir are provided in the A appendices. General camp protocols are provided in the Appendix B1. Guidelines for identification of salmon smolt are provided in Appendix C1.

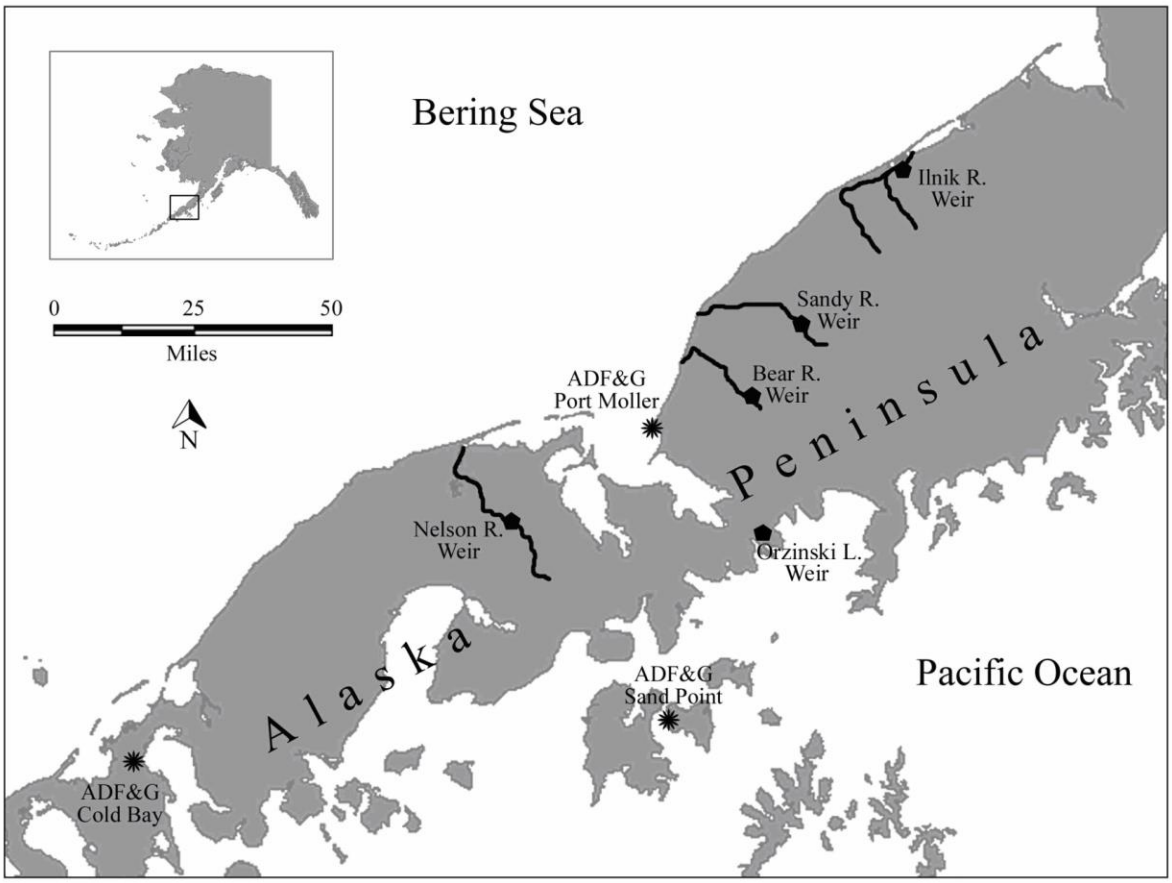

Figure 1.–Map of the Alaska Peninsula ADF&G seasonal offices and weir locations.

OBJECTIVES

LONG TERM

- Management of the salmon resources in the Alaska Peninsula Management Area for maximum sustainable yield by achievement of annual escapement objectives, forecasting improvement, development of stock-recruitment relationships to assess escapement requirements, and accurate assessment of stock composition.
- Develop a history of biological attributes and samples that may be used for genetic and long-term age studies.

SHORT TERM

- Enumerate salmon escapement by species and ensure interim escapement objectives are met throughout the season.
- Determine the sockeye salmon ASL composition for Bear, Sandy, Ilnik, and Nelson rivers, and Orzinski Lake.
- Determine the AWL composition of sockeye salmon smolt from Bear River.

METHODS

GENERAL WEIR PROTOCOLS

The main responsibility of a weir crew is to install, maintain and operate a salmon weir for the purpose of escapement enumeration and sampling. Two ADF&G personnel will be assigned to each project and additional assistance, if needed, will be provided during weir installation and removal.

Fish will be passed through the weir gates while being visually identified and enumerated by crew members using handheld tally counters. The crew will record each fish by species, as well as the number of net-marked and "jack" sockeye salmon (a fish which has spent only one year in salt water before returning to spawn). A sockeye salmon less than 16 inches (<400 mm) in length (mid-eye to tail fork) will be considered a jack salmon. The numbers of jack and net-marked salmon, as well as the ratio of males to females, are important factors when evaluating escapement quality. Typically the number of jack salmon is less than 10%. If the number of jack salmon, on a daily basis or for the season, is above 10%, the escapement objective may be increased to improved quality of escapement. Escapement objectives may also be increased if the number of net-marked fish becomes excessive, or if the ratio of males to females becomes skewed. The crew should report to their supervisor if they are recording high numbers of net-marked or jack salmon.

Large numbers of fish (>200) should not be allowed to build up behind the weir. The daily and cumulative escapement form will be used to record the daily escapement counts (Figure 2). On the daily counting form, note the time period when the weir gate is opened, and daily and cumulative counts for adult sockeye, jack sockeye, and other salmon species. Remarks such as weather, percentage of net marked fish, water levels, holes in the weir, approximate numbers of Dolly Varden *Salvelinus malma* or Steelhead *O. mykiss* passed, and other comments should be included in the remarks column to the right of the page. Additional comments can be included at the bottom of the page.

A minimum of 240 adult sockeye salmon will be sampled for ASL data in a live trap installed on the weir each statistical week throughout the season. At Bear River and Orzinski Lake, 200 sockeye salmon smolt will also be sampled each statistical week. Detailed procedures for sampling adult and smolt sockeye salmon can be found in the Kodiak Management Area salmon catch and escapement sampling operation plan (Wattum *In prep*).

In addition to enumerating and sampling salmon, the crew will maintain the weir to prevent holes from forming or the weir washing out. The weir must be kept clean of debris and the river substrate must be checked periodically throughout the day. In deeper channels a dry suit and diving mask will be needed to visually inspect the weir for holes. A complete inspection of the weir and a full cleaning must be done at least once a day. During high water the weir should be checked and cleaned multiple times a day as needed.

The weir crews at Nelson, Bear, Sandy, and Ilnik rivers will relay total daily counts and cumulative seasonal counts for each species to Port Moller during the normal radio or satellite phone schedule at 8:20 AM and 7:20 PM. The weir crew at Orzinski Lake will provide this information to Sand Point during the same schedule. When the project is completed all forms will be forwarded to Port Moller or Sand Point, as well as daily counting forms, camp log books, and sampling log books containing raw data.

Date: 7/23, 2011 Location: Bear River Weir

Gate Time		Adult Sockeye		Jack Sockeye		Total Sockeye	Other Salmon				Comments: water levels, holes
Opened	Closed	Hourly Count	Daily Cumulative	Hourly Count	Daily Cumulative	Daily Cumulative	Chinook	Pink	Chum	Coho	in the weir, weather, etc.
750	810	1038	1038	20	20	658	—	3	—	—	1 NM (Net Marked)
1000	1030	189	827	2	22	849	—	—	—	—	1 NM
1310	1330	258	1,085	19	41	1,126	—	5	—	—	
SAMPLE		~~74~~	1,159	6	47	1,206	—	—	—	—	Water 4.75 high!
1630	1700	388	1,547	31	78	1,625	—	9	—	—	3 NM
1840	1900	263	1,810	9	87	1,897	—	1	—	—	2 NM
2100	2120	256	2066	5	92	2158	—	Ø	—	—	1 large boat @ weir. Sow w/ cubs right after.
2245	2310	216	2,282	7	99	2,381	—	Ø	—	—	
Daily Total			2,282		99	2,381	Ø	18	Ø	Ø	
Previous Day's Total			163,996		1,310	165,306	1	35			
Season Cumulative			166,278		1,409	167,687	1	53	Ø	Ø	

Notes:

20-25 mph SW, 300 ft broken ceiling, unlimited gust up to 30 blue skies

Average Length = 523 mm

SAMPLED 80 Adults
Male = 40% Jacks = 8%
Female = 52% NM = 1%

Figure 2.–Bear, Nelson, Sandy, and Ilnik rivers, and Orzinski Lake daily and cumulative escapement reporting form.

Procedures for Daily Escapement Form

- Begin a new reporting form every day. Each day, copy the season cumulative totals for adults, jacks, sockeye total, and other species over from the previous day's sheet and enter them into the appropriate fields marked "Previous Day's Total" at the page bottom.
- After each count, record the time interval when the fish pass gate was opened under the "Gate Time".
- After each count, add the count from that period (under "Hourly Counts") to the running daily cumulative columns for both sockeye adults and jacks, then total all sockeye and record them under "Total Sockeye Daily Cumulative".
- Record other species counts in the appropriate columns.
- After the last count of the day sum all categories into the "Daily Total" row at the bottom of the sheet. Add the "Daily Total" row to the "Previous Day's Total" row to calculate the season cumulative for that day.
- Enter any notes such as water level, net marks, holes in the weir, etc., into the "comments" field on the right.
- Double-check all computations before reporting numbers to the Area Management Biologist during radio schedules.

BEAR RIVER WEIR

The Bear River weir (lat 56°02′24″ N, long 160°16′10″ W) is located approximately 400 m downstream of the outlet of Bear Lake, on the north side of the Alaska Peninsula (Figure 1). Bear River is home to the largest sockeye salmon run on the North Alaska Peninsula. The weir is roughly 50 m in length and the water depth varies from 1.0 m to 1.5 m.

The weir on Bear River will be installed on approximately May 31 and will be removed around August 25. The Bear River weir will be located approximately 400 meters downstream of the lake in roughly the same location as 2014. Care should be taken not to interfere with the approach of airplanes landing at the local lodge's landing strip upstream of the weir, and to offer mooring opportunities on the riverbank for lodge skiffs behind the weir. Detailed weir installation instructions for Bear River can be found in Appendix A1.

Two distinct runs of sockeye salmon, an early run and a late run, characterize the Bear River escapement (Table 1). The escapement goal for the early run, June 1 through July 31, is 176,000 to 293,000 sockeye salmon. The late-run escapement objective from August 1 through August 25 is a minimum of 87,000 sockeye salmon. The late-run total goal, including the post-weir estimate of 30,000 fish, is 117,000 to 195,000 sockeye salmon. The goal for the entire season including the post-weir estimate is 293,000 to 488,000 sockeye salmon. Escapements may be increased if escapement quality is poor because of a high percentage of jack or net-marked salmon.

Table 1.–Bear River weir sockeye salmon escapement management objectives.

Date	Escapement for period			Cumulative escapement		
Early-run component:						
15-Jun	4,000	-	8,000	4,000	-	8,000
20-Jun	11,000	-	22,000	15,000	-	30,000
25-Jun	15,000	-	25,000	30,000	-	55,000
30-Jun	30,000	-	60,000	60,000	-	115,000
5-Jul	30,000	-	50,000	90,000	-	165,000
10-Jul	25,000	-	35,000	115,000	-	200,000
15-Jul	15,000	-	30,000	130,000	-	230,000
20-Jul	10,000	-	20,000	140,000	-	250,000
25-Jul	20,000	-	20,000	160,000	-	270,000
31-Jul	16,000	-	23,000	176,000	-	293,000
Total early-run goal	176,000	-	293,000			
Late-run component:						
5-Aug	15,000	-	30,000	191,000	-	323,000
10-Aug	20,000	-	35,000	211,000	-	358,000
15-Aug	17,000	-	35,000	228,000	-	393,000
20-Aug	15,000	-	30,000	243,000	-	423,000
25-Aug	20,000	-	35,000	263,000	-	458,000
Total late-run objective:	87,000	-	165,000			
Post-weir objective	30,000					
Total late-run goal	117,000	-	195,000			
Season total escapement goal	293,000	-	488,000			

Note: Escapement occurring during the July 26–31 period that results in the escapement to exceed the 23,000 fish upper escapement objective, will be applied to the late-run escapement objective beginning August 1–5. However, no more than 15,000 fish shall be applied to the late-run escapement objective. This will aid the ADF&G in managing the late Bear River sockeye salmon run more effectively when the run is earlier than expected.

NELSON RIVER WEIR

The Nelson River weir (lat 55°48′99″ N, long 161°14′05″ W) is located about midway between the head of Nelson Lagoon and Sapsuk Lake (Figure 1). The weir is approximately 40 m in length with water depth varying between 0.6 m and 1.0 m.

The floating weir on Nelson River will be installed around June 1 and will operate until July 25. The location will be the same as previous years as indicated by the railroad rails located in the river about 100 m upstream of the ADF&G cabin. Detailed weir installation instructions for Nelson River can be found in Appendix A2.

The sockeye salmon escapement goal range for the Nelson River system is 97,000 to 219,000 fish (Table 2). Escapements may be increased if escapement quality is poor because of a high percentage of net-marked fish, a high percentage of jack salmon, or a low female to male sex ratio. The estimated number of female sockeye salmon in the escapement should range from 50,000 to 110,000 fish by July 25. Management staff in Port Moller will direct the crew at the Nelson River weir to sample the escapement as needed to determine the male to female sex ratio of fish passing the weir. A daily dip-net sample of 100 fish is typical. The escapement goal range

for Chinook salmon in the Nelson River system is 2,400 to 4,400 fish, though the actual number of Chinook salmon is generally estimated through aerial surveys.

Table 2.–Nelson River weir sockeye salmon escapement management objectives.

Date	Escapement for period			Cumulative Escapement		
30-Jun	30,000	-	60,000	30,000	-	60,000
5-Jul	20,000	-	45,000	50,000	-	105,000
10-Jul	20,000	-	50,000	70,000	-	155,000
15-Jul	15,000	-	30,000	85,000	-	185,000
20-Jul	10,000	-	25,000	95,000	-	210,000
25-Jul	2,000	-	9,000	97,000	-	219,000
Total	97,000	-	219,000			

SANDY RIVER WEIR

The Sandy River weir (lat 56°11′94″ N, long 160°01′53″ W long) is located approximately 5 km below Sandy Lake (Figure 1). The weir is roughly 61 m in length with water depth varying between 0.6 m and 1.5 m.

The weir is typically installed around June 5 and will operate until about July 25. The weir should be reinstalled in roughly the same location as it was in the previous year after assessing the quality of the site in terms of river depth, channel development, and substrate stability.

Due to the notable fluctuations in water level and debris load that Sandy River experiences, extra precautions will be taken to secure the tripods during installation. After the stringers and catwalk are in place, sufficient sandbags should be stacked on the tripod platforms and against the back legs to hold the tripods securely when the panels are installed. Weir maintenance is especially important at Sandy River to minimize the force of the river on the weir. The weir will be kept clean of debris and checked as often as needed to ensure there are no holes for fish to escape through. Dry suits and diving masks will be needed to visually inspect the weir at least once a day to make certain that it is fish tight. Detailed weir installation instructions for Sandy River can be found in Appendix A3.

The Sandy River sockeye salmon annual escapement goal is 34,000 to 74,000 fish (Table 3). If weir counts are unavailable due to difficulties with the weir such as a high water event, aerial survey data will be used to estimate the escapement and manage the fisheries.

Table 3.–Sandy River weir sockeye salmon escapement management objectives.

Date	Escapement for period	Cumulative escapement
20-Jun	2,000 - 3,000	2,000 - 3,000
25-Jun	4,000 - 8,000	6,000 - 11,000
30-Jun	7,000 - 17,000	13,000 - 28,000
5-Jul	8,000 - 19,000	21,000 - 47,000
10-Jul	5,000 - 13,000	26,000 - 60,000
15-Jul	3,000 - 7,000	29,000 - 67,000
20-Jul	3,000 - 4,000	32,000 - 71,000
25-Jul	2,000 - 3,000	34,000 - 74,000
Total	34,000 - 74,000	

ILNIK RIVER WEIR

The Ilnik River weir (lat 56°36′73″ N, long 159°34′28″ W) is located approximately 3 km below the Ilnik Village site (Figure 1). The weir is the longest in the state at about 150 m in length with varying water depth between 0.2 m and 2.0 m.

The Ilnik River weir will be installed on approximately May 27 and will operate until July 20. The floating weir will be installed in the same location as in previous years. Weir maintenance is extremely important at Ilnik River to decrease the likelihood of the weir washing out or being submerged due to debris loading. The large amount of algae washing down from Ilnik Lake accumulates on panels and forces the weir to sink, allowing fish to escape over the top of the panels. The weir should be kept clean of debris and checked often to ensure there are no holes for fish to escape. In the deeper channels, a dry suit and diving mask will be needed to visually inspect the weir to make certain that it is fish tight. For a detailed discussion of the installation of the Ilnik River weir, refer to Appendix A4.

If weekly escapement sampling is not possible due to inclement weather or other circumstances, ASL data will be collected (upon approval from Port Moller management staff) from the set gillnet fishery (if present) in Ilnik Lagoon.

The Ilnik River sockeye salmon annual escapement goal is normally 40,000 to 60,000 fish (Table 4). In 1972–1975, 1986–1987, 2005–2010, 2012, and 2013, the Ocean River, a tributary to the Ilnik River system, flowed directly into the Bering Sea rather than into Ilnik Lake. When this occurs, many of the fish bound for Ocean River do not pass through the Ilnik River system, and therefore do not pass the weir. For the years noted above, an average of 20% of the Ilnik River system escapement spawned in Ocean River. If the Ocean River were to flow directly into the Bering Sea over a given summer, the Ocean River escapement objective of 8,000–12,000 sockeye salmon would be subtracted from the total Ilnik River escapement goal (Table 5).

Table 4.–Ilnik River sockeye salmon escapement management objectives if Ocean River flows into Ilnik Lake.

Date	Escapement for period			Cumulative escapement		
20-Jun	5,000	-	8,000	5,000	-	8,000
25-Jun	5,000	-	7,000	10,000	-	15,000
30-Jun	5,000	-	10,000	15,000	-	25,000
5-Jul	5,000	-	10,000	20,000	-	35,000
10-Jul			10,000	30,000	-	45,000
15-Jul			5,000	35,000	-	50,000
20-Jul	3,000	-	7,000	38,000	-	57,000
25-Jul	2,000	-	3,000	40,000	-	60,000
Total	40,000	-	60,000			

Table 5.–Ilnik River sockeye salmon escapement management objectives if Ocean River flows directly into the Bering Sea.

Date	Escapement for Period			Cumulative escapement		
20-Jun	4,000	-	6,400	4,000	-	6,400
25-Jun	4,000	-	5,600	8,000	-	12,000
30-Jun	4,000	-	8,000	12,000	-	20,000
5-Jul	4,000	-	8,000	16,000	-	28,000
10-Jul			8,000	24,000	-	36,000
15-Jul			4,000	28,000	-	40,000
20-Jul	3,000	-	5,600	31,000	-	45,600
25-Jul	1,000	-	2,400	32,000	-	48,000
Total	32,000	-	48,000			

ORZINSKI LAKE WEIR

The Orzinski Lake weir (lat 55°43′78″ N, long 160°05′70″ W) is located near the outlet of Orzinski Lake, approximately 1 km upstream of the river's terminus in Orzinski Bay (Figure 1).

The Orzinski Lake weir project will be operated in the same location as in recent years, approximately 50 m below the lake outlet, from about June 7 to August 5. For a detailed discussion of the installation of the Orzinski Lake weir refer to Appendix A5.

Sockeye salmon usually begin entering Orzinski Lake in mid-June, normally 50% of the annual escapement has been achieved by the second week of July. The Orzinski Lake sockeye salmon annual escapement goal is 15,000 to 20,000 fish (Table 6).

Table 6.–Orzinski Lake sockeye salmon escapement management objectives.

Date	Escapement for period			Cumulative escapement		
1-Jul	1,500	-	2,000	1,500	-	2,000
9-Jul	2,250	-	3,000	3,750	-	5,000
16-Jul	3,750	-	5,000	7,500	-	10,000
23-Jul	3,750	-	5,000	11,250	-	15,000
7-Aug	3,750		5,000	15,000	-	20,000
Season total goal	15,000	-	20,000			

GENERAL CAMP PROTOCOLS

Well maintained camps and facilities allow projects to be accomplished comfortably and efficiently. Maintenance can usually be accomplished during slow periods of the season. As soon as the camp is established, facilities should be looked over and a list made of projects that need to be accomplished. The supervisor should be notified of any materials needed. Anticipate needs before they become a problem

Appendix B1 provides general information including radio schedules, ordering food and supplies, compliance with ADF&G regulations, equipment/maintenance, procedures regarding fish and wildlife violation reporting, emergencies, firearms, bears, garbage, boating, fire and first aid safety, drinking water, personal gear, compatibility of field personnel, and cleanliness of cabin.

SCHEDULE AND DELIVERABLES

The schedule of activities for the weir operation season is as follows:

Date:	Activity:
May 26–May 29	Open Ilnik camp and install weir
May 28–May 30	Open Bear camp and install weir
June 1–June 4	Open Nelson camp and install weir
June 4–June 7	Open Sandy camp and install weir
June 4–June 10	Open Orzinski camp and install weir
Daily	Enumerate salmon and report escapement numbers to supervisors at morning and evening radio schedule, camp chores and maintenance
Weekly	Sample 240 adult sockeye salmon
Weekly	Sample 200 smolt sockeye salmon (Bear and Orzinski)
As flights are available	Send in collected samples and thumb drives to field office (Port Moller or Sand Point)
July 15–August 7	Close Ilnik, Sandy and Nelson camps, remove weirs
August 4–August 10	Close Orzinski camp, remove weir
August 25–August 28	Close Bear camp, remove weir
End of each camp field season	Return all necessary camp equipment and weir logbooks/samples to supervisor
Post field season	Take escapement data and samples back to Kodiak, age scales, complete management reports

RESPONSIBILITIES

Fisheries Biologist III	Overall Project Leader
Fishery Biologist II	Supervise project, assist in field sampling as needed, coordinate logistics
Fishery Biologist I	Crew leader, training of new personnel in sampling and assist in field sampling as needed, assist in office and with maintenance
Fish and Wildlife Technician III	Crew leader, responsible for daily operation and maintenance of weir, reports escapement data to supervisor, maintains logbooks/journal
Fish and Wildlife Technician II	Assists in daily operation of weir, performs tasks as assigned by crew leader

SUPERVISION

The Assistant Area Management Biologist (AAMB) Reid Johnson and Area Management Biologist (AMB) Robert Murphy, both based in Port Moller, will supervise the Nelson, Bear, Sandy, and Ilnik river weir crews. The Sand Point AAMB and AMB (Charles Russell and Matthew Keyse respectively) will supervise the Orzinski Lake weir crew. Day to day operations, task scheduling, and ensuring work quality will be the responsibility of the crew leader designated for individual camps.

During the operation of the weir, assigned duties may take longer than 37.5 hours/week to accomplish. When this is expected at Bear, Sandy, Nelson, or Ilnik rivers, notify the AAMB in Port Moller, if this is expected at Orzinski Lake notify the AAMB in Sand Point prior to actually doing work in excess of 37.5 hours/week. They will decide what projects take priority and authorize overtime if necessary. No overtime may be worked or claimed unless it is first authorized.

DATA REPORTING

A Fishery Management Report will be completed by March of the year following the fishing season, which includes the ASL composition results of the escapement sampling season. Further escapement information and commercial fishery catch data will be described in the Alaska Peninsula Annual Salmon Management Reports authored by Robert Murphy, Matthew Keyse, Reid Johnson, and Charles Russel, and will be completed by April the following year.

The Port Moller AAMB and the Sand Point AAMB will provide daily weir counts, by species and weir, to the Kodiak office for entry into the regional escapement database. Regional AMBs are responsible for editing escapement counts by weir and species for accuracy.

REFERENCES CITED

Wattum, M. L. *In Prep*. Kodiak Management Area salmon catch and escapement sampling operational plan, 2015. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Operational Plan, Kodiak.

APPENDIX A. BEAR, NELSON, SANDY, AND ILNIK RIVERS, AND ORZINSKI LAKE WEIR INSTALLATION PROCEDURES

INSTALLATION

MATERIALS

All weir installation materials are stacked on the bank of the river at the installation location. The materials are divided roughly in half on either bank. You will need the following items to install the weir and do repairs on the tripods:

- Claw (framing) hammer
- 2-3lb hand sledge
- Hand saw
- Wire cutters
- Vise-grips
- 16 penny nails (for attaching sandbag platform boards and catwalk boards)
- 20 penny nails (for stringer supports)
- Dock spikes (for reinforcing main tripod timbers)
- A number of 2x4's (for tripod sandbag platform)
- Bailing wire or long, strong zip-ties

LOCATION SELECTION

Weir location selection is critical to subsequent ease of weir maintenance, access, and safety. The weir should be installed roughly in the same location as the previous year. The riverbed should be thoroughly profiled by walking across the river a number of times to determine where any holes, gravel bars, or channels exist which could cause problems with alignment or installation. Choose a transect which offers the smoothest, best consolidated, and most continuously regular substrate possible. Keep in mind that the weir should run roughly perpendicular to the river's current in the deepest, fastest channel. Place a stake or sandbag on each bank at either end of the chosen transect so that you have a target to work towards and a fixed reference point to sight-off of to check tripod alignment.

The Bear River camp sits in close proximity to Bear Lake Lodge. Often lodge employees run river boats downstream so an agreement should be made with lodge personnel prior to installing the weir. To prevent having to take out sections of the weir later on, ask the lodge if they want to put their skiffs below the weir before it gets installed. A boat gate was built in 2008 to allow for skiffs to pass without interruption or assistance from ADF&G crew, however, it wasn't "bear proof" and fish escaped without notice.

Bear River water levels are generally low in spring when the weir is installed, but can be expected to rise significantly (two feet and more) over the course of the summer. In some years, two distinct peaks in water level can be observed which correspond roughly with the peaks in the salmon runs. The water can rise as much as two feet in 24 hours, usually as a result of heavy rains, warm weather melting snow and glaciers, and high winds off the lake, so be prepared for the worst early in the season. During high water events extra care must to taken to clean and maintain the weir. It is better to spend a few extra hours a day cleaning the weir than it is to spend a few extra days reinstalling a washed out weir.

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TRIPOD PLACEMENT

The weir generally uses 20 to 23 tripods, so you may end up with one or two spare. Begin on either side, but it is important to use the older, weaker tripods where the current is slack. Check the 20 penny nails in the front leg of the tripod where the stringers will rest before placing them in the water as it is hard to drive new ones in place when the leg is underwater. When rolling the tripods to the river, make every attempt to be gentle so that the timbers do not split or part, and that the nails on the front leg are not bent. Place the tripods so that the back legs have about 4 inches of gap between them (the width of your foot) and mount stringers on the front leg as you work. Make sure there is 4-8 inches of overlap on either end of the stringer where it meets the tripods. Adjust the spacing of the tripods to maintain adequate stringer overlap. Allow more overlap where the current is stronger and the water is deeper. This will allow some tripod settling and traveling without the stringers being pulled off the front leg.

As you work, check the alignment by sighting down the stringers towards the target stake or sandbag on the far bank. The tripods placed in deeper water may require some sandbags to keep them from moving in the current. Once you have found the correct position for the tripod, push it back and forth forcefully to work the legs down into the gravel and set them in place. This will help minimize movement later. Recheck alignment periodically. Proper alignment of the tripods is critical to having the panels lay flat on the stringers and prevent gaps between panels later. A little extra care and effort at this stage can save countless hours of weir maintenance later in the season when the water level rises. A weir that is not completely straight will collect concentrated debris in crooked areas, increasing that chance that the weir will wash out due to debris load.

Once the tripods are set and the stringers are on, spend some time loading the platforms with sandbags as the resistance will increase dramatically once the weir panels are put on. The tripods in the shallow, slow moving water near the banks may need as few as six sandbags each, while the deeper tripods may require 40 or more. If you begin installing the weir late in the afternoon, this is a good place to stop for the day to allow the tripods to settle down into the substrate overnight before adding the resistance of the panels. This additional resistance can cause the tripods to settle back as well as down, negating much of the effort devoted to alignment.

Keep in mind that the weir generally fails due to sandbags being washed off the tripod platforms, so sandbag placement is critical to surviving episodes of high water. The sandbags should be wedged between the tripod legs as tightly as possible. Eventually, additional sandbags can be stacked on the wings behind the back legs, and a small platform can be added to the crown of the tripod for additional bags. Nail one or two planks across the back of the rear legs above the wing support to keep sandbags from washing off the back of the platform once it is loaded.

PANEL INSTALLATION

Place the panels on the weir starting on one end making sure that the panels are perfectly perpendicular to the water surface. You will likely have to dig into the substrate to allow the entire bottom of the panel to rest in the gravel as you descend the banks or move past irregularities in the gravel. Hop up and down on the t-angle crosspiece of the panels to push the panel down into the gravel. As you go, do not forget to install the three gates at intervals that cover different water depths. Two gates will be used as fish passes, and one will lead into the sampling trap. As the water level and turbidity rise, you may need to switch to a fish pass gate in shallower water, so install the gates leaving yourself some future options (such as one in the deepest channel, and another closer to the bank). Think about where you want the trap and install a gate for this purpose as well.

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Finally, put the catwalk boards on and use them for shuttling more sandbags onto the weir. All boards should overlap on a tripod wing. If necessary, blocks can be nailed to the tripod wings if the catwalk board does not meet the wing properly.

Line the entire front of the weir with sandbags to prevent scouring below the panels. Later, in August, pinks will accumulate in front of the weir to spawn. While digging their redds (nests), they throw prodigious quantities of gravel up on the front of the weir, which becomes a maintenance concern on the weir. Bears will swim back and forth in front of the weir, also throwing gravel up on the panels. Laying weir panels flat on the river bottom in front of the weir helps keep the rocks from being kicked up. Lay the panels parallel to the weir and hold them down with a few sandbags.

Zip-ties can be used to attach the panels to the stringers and join panels where they meet in order to keep the panels from shifting and make it more difficult for bears to knock the panels free. Another method of keeping bears from opening holes in the ends of the weir is to stack numerous panels against the weir. The bears typically will pull one or two free, but then lose interest.

TRAP ASSEMBLY

To assemble the fish trap, you will need:

- 3 full-sized weir panels
- 2 panels which have been cut off at an angle on one end
- 3 half-panels (cut lengthwise)
- 6 fence posts
- 2-3 lb hand maul or post-pounder
- Bailing wire or long, strong zip-ties
- Wire cutters
- Vice-grips

The trap is most effective if it is installed offset to one side of the fish gate so that you can run the sampling net up a weir panel and not leave any gap through which the fish can escape past the net. Begin by laying a full sized panel on its side pointing upstream, letting the downstream end rest against the base of the weir next to one side of the fish gate. Pound two fence post in at both ends and wire the panel to the posts to hold it. Measure the distance between the top and bottom t-angle cross pieces of a panel. Measure out this distance across the face of the weir and put another full sized panel parallel to the other panel that was just put in. Pound two more fence posts in and wire the panel to them for support. Next, stand well upstream of the open end of the trap with the last full sized panel. Holding the panel vertically on its side and parallel to the weir, in one movement sink the panel down into the water and walk forward with it as the current moves it downstream until it rest against the two existing panels jutting out from the face of the weir. You should now have a mostly enclosed box sitting in front of the gate. The gaps at the downstream ends of the side panels of the trap can be closed using the diagonally cut panels. Put the cut panels on the inside of the side panels with the cut ends resting on the river bottom and the short side resting against the face of the weir. Secure everything in place using bailing wire. Add more fence posts to reinforce the structure as needed. The three lengthwise half panels are available to make the sides of the trap taller if the water should rise, and to put the measuring table at a comfortable working height.

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MAINTENANCE

The weir needs to be cleaned thoroughly at least once a day. A dry suit and snorkel mask will be needed for this task in order to clean and inspect the foot of the weir panels. During high water events the weir may need to be cleaned more than once a day. Consistent and thorough weir maintenance prevents major problems from forming.

Holes should be patched using sandbags or extra panels if the hole is big enough to warrant. Generally if two fingers can fit easily through a hole, a salmon can squeeze through, holes larger than two fingers should be patched.

REMOVAL

Starting at the far end of the river, remove the sandbags from the foot of the weir, followed by panels, stringers, and eventually the sandbags weighing the tripods down. Be sure to leave enough sandbags on the tripod to keep it from floating away. The boat can be used to ferry these items back to shore to be stacked neatly. Take care not to overload the boat. The tripods should be arranged neatly for easy access during the start of the next season. All items should be stored away from the river bank, as spring flooding and ice may easily carry weir materials downriver if left on the river bank.

Once all materials are out of the river and stacked neatly they must be secured. Rope should be used to tightly bind all the tripods together, preventing bears from separating them, and preventing flood events from carrying single tripods away. The panels should be tied down either with ground line or bailing wire.

INSTALLATION

MATERIALS

- Vice grips, at least 4
- Sledge hammer
- Impact mallet
- Bailing wire
- Zip ties
- Rope
- Buoys
- Fid
- A Panels
- B Panels
- Chain link fencing
- Wire cutters
- J hooks
- Rebar

PREINSTALLATION INSPECTION

Upon arriving at the Nelson (Sapsuk) River field camp, inspect the over-wintering condition of the following weir components and relay the condition of them to the Port Moller ADF&G office at the next radio schedule.

- The rail
- The south bank stabilization structures
- The winch stanchion and north bank deck
- The weir trap and funnel (located on the south bank)
- The weir panel piles (There should be piles on the north bank and on the south bank)
- The Beebe winch
- The chain link fencing on either side of the rail

The rail should be embedded, straight, and roughly perpendicular to the stream banks. Some or all of it may be covered with gravel deposited during the winter. Before installation begins, check to ensure that an erosion hole has not developed under the rail.

The south bank should be reinforced with a two-gabion length complex just downstream of an angled gabion as well as the plywood bulkhead.

Check to see if the winch stanchion and north bank deck is intact. The deck surface should be level. The stanchion should be upright and straight. The base of the stanchion should line up with the end of the rail and a pulley should be mounted where the stanchion and the rail meet.

The weir trap and funnel should be secured to fence posts on the south bank. They are oriented parallel to the bank and the trap is upstream of the funnel.

The four weir panel piles should be secured to fence posts and covered with plywood and aluminum panels to help protect the plastic from UV light.

The Beebe winch can be found on the floor of the tool shed next to the cabin.

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The chain link fencing should cover 4-5 ft above and below the whole length of the rail. The fencing rusts over time, so it needs to be inspected for weakness. Do this by tugging firmly on the chain link, rusted chain link will break easily, and must be replaced. Directions for replacing the chain link can be found at the end of this appendix.

PREPARATION

It is important to realize that it is better to take your time during weir installation, do a good job, and make sure all needed repairs are done before anything goes into the water. This will lead to less weir maintenance later on for the crew. It also means that at the end of the season everything can be put away quickly because there will be less repair work. Keep this in mind when considering the condition of the weir panels, the rail, and the chain link fencing on either side of the rail. These components are both extremely important and extremely time intensive to replace or repair. These repairs cannot be put off till the end of the season.

The rail's entire surface, including all of its eyes, must be cleared of all silt and gravel. A dry suit, hood, snorkel, mask, and sturdy garden rake are needed for this task. Rake substrate off and downstream of the rail surface. Ream out each rail eye with an individual rake tooth. This action is necessary to clean each eye, facilitating cable stringing and preventing the cable from jamming during installation. If the rail has been undermined, sandbags will need to be placed both upstream and downstream of the rail to fill the void. After the sand bags have been positioned, a piece of chain link fencing should be securely staked down over the sand bags by driving metal "J" hooks around the edges of the new piece with a heavy hammer. High water events have caused damage to the chain link fencing over recent years so repairs are usually necessary before weir installation. The chain link fencing should cover 4-5 ft above and below the whole length of railroad rails.

The next task is to clear sediment from the area around each rail end near each bank. This is necessary not only to clear the eyes on the rail, but also to preserve visibility in the water when installing the first and last panels. This makes installing these panels much easier. The next task is to install the Beebe winch on the stanchion and string the cable through the rail eyes. Two steel "J" hooks located in the tool shed are a handy tool for lifting the awkward, heavy winch. Insert each "J" hook through a different pair of bolt holes on the mounting flange of the winch. By holding the hook, two strong people can carry the winch down to the winch deck. It is ideal and safer for four people to carry and install the winch if help permits.

The winch is mounted to the stanchion with four bolts, washers, and nuts located in a zip lock bag in the gray plastic toolbox in the shed. The winch is bolted to the north side of the stanchion with its handle pointing downstream. Insert the bolts through the winch and attach the washers and nuts on the south (offshore) side of the stanchion.

Loosen the winch cable from the spool and pull the cable down the stanchion between the stanchion and the pulley, then under the pulley and through each rail eye. One person operates the winch providing cable slack while another person, in a dry suit, pulls out about 10 to 15 feet of cable at a time and then threads the cable end through each eye in the rail. If more slack is pulled out at any one time, the cable tends to get snagged on itself. This process is repeated until the cable is threaded through all the eyes across the river. Extreme care must be taken to thread the cable through all the eyes in the rail. If any of the eyes are missed, any work toward installation of the weir will have to be undone to rethread the cable.

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Upon reaching the south stream margin, loop the winch cable through the south bank deadman anchor cable and clamp the cable back on itself. (A deadman loop should be protruding through the plywood of the bulkhead right over the end of the rail.) Before clamping the cable on, measure the distance of the first weir panel's cable hook from the edge of the panel. (The first panel is one of two unique panels stored on the south bank with "gasket" material (herring web) attached to the left side of the panel, when looking at the panel right side up from the upstream end.) The loop formed when the winch cable is clamped on itself must be shorter (including all the clamps attaching the cable) than this distance to prevent interfering with installing the first panel snugly against the bulkhead. Three cable clamps are sufficient to attach the cable. Cable clamps must be tight so the cable will not slip under the strain that will be on when the weir is installed. The clamps should be attached with the cable end to the clamp loop side. Ideally, the cable clamps will also be installed on the shoreward side of the closest eye on the rail.

The next task is to prepare the panels which are stacked in neat piles on both sides of the river. Upon reconstruction of the new weir in 2008 panels were separated as "A" and "B" panels to eliminate confusion. The cross members on the "A" panels are spaced differently than the "B" panels so the straps for the connector rods align correctly when installing the weir. The "B" panels are differentiated by the orange spray-painted end caps. The south bank should have a total of 26 panels (13 "A" panels and 13 "B" panels). The north bank should have a total of 14 panels (eight "A" panels and six "B" panels). Unwire the panel stacks and consolidate the lengths of wire by placing them on the winch deck. Pull the fence posts out of the ground and store them away from the panels to prevent tripping. Carry the panels one at a time, towards the river upstream of the weir. Two people can easily carry one panel. One unique panel is a bit narrower than the rest (only nine pickets wide) and will be needed for the last panel to fit between the bank on near side. Be sure you have everything prepared prior to installing the weir.

Repair work on panels should be done before they are in the water. It is easier to repair the panels on land, and the quality of work done is accordingly higher. It saves time and effort to do repair work at the start of the season. Quality repair work also leads to less time spent on weir maintenance later in the season.

Most of the straps for the connector rods will need to be replaced before installing the weir. Replace any straps, cross-member pieces, pickets, or eyebolts as needed to maintain the function of each panel. Flag repair sites with surveyor tape and remove tape after repairs are made. There should be a total of 4 panels (3 on the far bank, 1 on the near bank) with gasket material attached to them in preparation for connecting with either a stream bank or funnel opening. All four panes with webbing are "A" panels. Ensure that these gaskets have no holes and the web is not rotten or in need of repair. The web should be wide enough to allow the floating panel attached to it to move freely in response to extreme changes in water levels while still not allowing fish to escape upstream. The gasket should extend along the entire length of the floating panel to which it is attached. The gasket on the panel interfacing with the north (near) bank will need especially deep web material since the shoreward attachment point is up over the bulkhead wall on the edge of the winch deck. The gaskets for panels proximate to the far bank and the funnel should have an uncapped 13-foot length of PVC pipe (connector pipe) laced to the edge of the gasket opposite the side attached to the panel. Make sure the lacing is snug and in good repair.If a panel needs to be repaired and/or rebuilt, the necessary hardware and notes for panel assembly can be found at the end of Appendix D2.

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The far side also should have the fish trap with two gates and numbered panels for the trap. Two long gang-plank boards used as a cat-walk to the trap from the bank can be found under the cabin and need to be brought across the river. All the PVC pipes (connector rods) for securing the panels next to each other are also located under the cabin. You will need at least 37 connector rods for completing the weir. The aluminum panels in which the panels are stacked on need to be taken to the other side of the river, and are used for the caging around the funnel frame.

INSTALLING PANELS

The weir is 40 panels wide. Panels are installed one at a time starting from the south bank (far bank) stream margin and progressing across the river toward the north bank and the winch stanchion. Begin with an "A" panel that has webbing material. A "B" panel is installed next, then another "A" panel with webbing. After the first three panels are installed, the funnel frame can be carefully carried down the bank and placed on the downstream side of the railroad rail. The funnel can temporarily be stabilized by putting few sand bags on it to prevent it from shifting or moving downstream. Another "A" panel with webbing is installed on the other side of the funnel, then alternate B, A, B, A from this point on.

After the fourth panel is installed, vice grips are needed to keep the panels in place. At least four vice grips will be needed during weir installation. Begin with a pair on each panel proximate to the funnel. For the panel south of the funnel, put each of the two vice grips on the cable immediately north of each of the two hook eyes. For the panel north of the funnel, put each of the two vice grips immediately south of each of the two hook eyes. Make sure that each vice grip is clamped as tight as possible on the cable, to prevent slipping.

As a reminder, the first, third, fourth and 40th panels have gasket material on the appropriate edge necessary to interface with either of the banks or the sides of the funnel.
To install each panel requires (at least in the swifter/deeper sections) two people to handle transporting panels into and maneuvering in the water. These folks will all need to be in dry suits with snorkels and masks and (in deeper sections) weight belts. A fourth person (if available) will operate the winch. If a fourth person is not available, one of the other three people will have to walk back and forth between the weir panel installation site and the winch stanchion when necessary to operate the winch.

First, one person unlocks the winch and lets out slack (usually about 15 rotations of the handle when the winch is in the slower gear) while a second person pulls the excess cable upstream in a slight loop in the area where the panel is intended to be installed. The cable should have enough slack so the cable can be lifted 8–12 inches off the rail.

By staging the majority of the panels upstream of the rail, the panels can be more easily maneuvered into position as they are floated across and downstream and pulling against the current will be minimized.
The panel is floated into a position slightly upstream of the rail where it will be installed and held there by the two people holding onto the panel. A third person pushes down on the upstream end of the panel while reaching down and hooking the loose cable onto the pair of hook eyes in the foot of the panel.

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When it is in the correct position, a signal will be given to the winch operator to take up the slack previously paid out. As the slack is being slowly taken up the panel should be continually checked for correct placement and adjustments should be made to the location of the panel as necessary. At this point the winch operator should ensure that all slack is taken back out of the cable. The foot-plate of each panel has short metal pegs or "ears" which stick out on either end. The PVC connector rods that join neighboring panels will slip down over these ears to rest against the foot of the weir. When in the correct position, the ears of neighboring panels should line up and be in close enough proximity so that the end of a connector pipe (16-foot length of 1" conduit with no end caps) will slip over both ears. It is sometimes necessary to make slight adjustments in panel location once the cable is already tightened. This may be accomplished by judicious use of a short crow bar or three pound hammer to move a panel slightly. (All tools used in water should be spray painted orange prior to weir installation to assist in finding them if dropped.) Care should be taken not to pry or hammer on the edge pipe or pipe clamp as they may be easily pulled loose.

Once each panel is in correct position and the slack is taken from the cable, a connector pipe must be installed to connect it with the previously installed panel. This takes the teamwork and finesse of the two people left in the water. If connector rings between the panels line up and do not overlap, the cross member on the panel being connected can be moved up or down slightly by tapping on it with a hammer so the rings can be lined up. One person threads a connector pipe through the rings starting with the most extreme downstream ring between the two panels being connected. Most connector pipes will have small holes drilled into them closer (about one third of their length) from one end than the other. When threading these connector pipes, position the pipe so the end furthest away from these small holes is upstream (and threaded first through the connector rings).

The other person (preferably the lightest person, as they will warp the panels less with their weight) straddles the adjoining panels and threads the up-stream end of the pipe through the rings and over the ears on the upstream end of the panels as the first person gently pushes the connector pipe upstream. When installed, the connector pipe should fit snugly over both ears of the adjoining panels. (The person pushing generally gently pushes while simultaneously twisting the pipe to help it more easily thread through the rings.)

After the connector pipe is installed, and the panel is inspected to make sure it is installed correctly, a pair of vice grips should be clamped tightly on the cable immediately north of each of the hook eyes on the recently installed panel. As panels are installed across the river, the two most recently installed panels should be clamped with vice grips to prevent the partially installed weir from slipping on the cable when slack is paid out for subsequent panel installation. In addition, vice grips should be left holding both panels next to the funnel until the entire weir is in and the funnel is installed. As weir panels are installed sequentially across the river, vice grips can be leapfrogged to newly installed panels from ones further back that no longer need to be held in place.

Once the vice grips are in place, the panel installation process is repeated, first by loosening the cable, and then installing the next panel. It may be necessary to use the narrower panel in the final (39^{th}) location on the rail proximate to the north bank if there is not room for the full width one with gasket material on the right side (looking at it from the bottom, right side up).

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TRAP AND FUNNEL INSTALLATION

After all the panels are installed, the trap and funnel complex is installed. First it is necessary to clean and level the trap site by removing sandbags and excess gravel. This is necessary to insure the trap floor (made of white sandbags) will be low enough, even at low waters levels, to be conducive to fish trapping and passage. The site should be level and slightly deeper than the surrounding riverbed. The rough outline of last year's trap location should be apparent from the general sandbag pattern of distribution and can be used as a guide when preparing the site.

Once the site is prepared, the trap frame, stored on the south bank, is carefully carried into the river (this will take three to four people) and placed in the slightly depressed hole prepared for it. It may be necessary to remove the frame and remove additional gravel to make it level and low enough. When in place, the downstream end of the trap should fit snugly up over the rail. The trap should be oriented roughly perpendicular and upstream the rail.

The funnel now needs to be placed roughly into position. The area the funnel sits in should be fairly level so that the funnel sits on stable ground. Sandbags should be used to level the stream bottom out if needed. The funnel should be placed downstream of the trap, fairly close to the rail, both perpendicular to the rail and in line with the trap. Make sure the funnel is placed in the water in accordance with the upstream and downstream markings on either end. The funnel will be adjusted and made flush to the trap after the trap is finished being constructed.

Next, the aluminum panels (also stored on the south bank) are zip tied or wired to the outside of the frame on each side. Each aluminum weir panel (already numbered) is placed straight up and down in the spot corresponding with the same number marked on the frame. The bottom of each panel should fit snugly in the angle of the frame so no gaps exist where fish could get through. There should be four panels for each side. Next, six fence posts should be driven into the bottom (about 12 to 18 inches) near the upright members of the trap frame outside the trap with a post driver. They should be wired or zip tied tightly to the trap frame to help hold it in place.

Next, the bottom of the trap is lined with a layer of white sandbags. Just upstream of the trap, position the flash panel for counting fish. Sand bags will be needed to hold down the flash panel. Sand bags are also used to hold the trap in place, make fish in the trap more visible and seal any minor holes where fish might escape. Finally the sliding door panels are installed in both ends of the trap. Make sure that the doors open and close easily. It may be necessary to realign a frame or trim a door panel to make it slide easier. Also make sure each door fits snugly to the sandbags comprising the flash panel so that fish will not pass undetected when it is closed.

After the trap is in place the funnel should be adjusted so that it is flush with the trap. Once the funnel and trap are flush they should be bolted together. Fence posts should then be driven into the ground around the upright members of the funnel. The funnel will then be wired to the fence posts in order to secure the funnel in place.

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GASKET INSTALLATION

After the funnel and trap are in place, the four herring web gaskets need to be attached either to a bank or a side of the funnel. On either side of the funnel the PVC bar should be zip tied tightly to the top of the funnel. The upstream end of the gasket should be zip tied tightly to the funnel, and the other PVC bar should be zip tied tightly to the floating weir panel. Make sure no gaps exist that a fish could swim through. On the south bank, a connector pipe (13 foot long piece of 1" PVC pipe with uncapped ends), already laced to the edge of the gasket material, is attached to the plywood bulkhead wall with nails and pipe hanger. On the north bank, the shoreward edge of the gasket is affixed to the edge of the winch deck by nailing 2x4s down over it. On each side of the funnel a connector pipe, already laced to the edge of the gasket material, is zip tied or wired (snugly) to the outside of the funnel. Care must be taken to ensure the gaskets are attached so as to allow the proximate floating weir panels to move freely in response to varying water levels and not let fish escape upstream undetected.

SECURING CONNECTOR PIPES

After the gaskets are installed the next step is to secure the connector pipes between floating weir panels so the water does not cause them to back off the connecting ears on the upstream corners of adjoining panels. Most connector pipes, if already used, will have small holes drilled about one third of the way upstream from the downstream end of the connector pipe (if installed properly) and just upstream of the most downstream set of connector rings. A six-inch piece of wire is threaded through these holes and twisted back over itself two or three times. If a hole is not in the right spot, a cordless drill can be used to put one where it is needed. All 37 connector pipes should be secured in this fashion. (Do not drill hole while standing in the water! Any holes in connector pipes should be drilled from the bow of a skiff.)

The last task before declaring the weir fish tight is to look for and plug any leaks in the weir. A dry suit and snorkel are necessary to closely inspect the entire weir underwater for any holes that could potentially leak fish. Holes are not always apparent when looking through the surface of the water.

Generally, a hole in the weir wider than 1.25 inches or so could potentially allow fish to pass and should be plugged. Look for irregularities in the weir or the bottom, which could be potential holes. Holes close to the bottom can usually be plugged with a couple of carefully placed sandbags. Holes higher in the water column might be plugged by using a zip tie or wire to secure a picket near the center of an existing void. Pay special attention to the upstream end of gaskets near the rail. Also inspect the trap to ensure fish will not escape under the sides of the trap. Usually, several sandbags are placed around the outside of the trap to ensure fish will not escape. The usual trouble spots near the trap are on the downstream end, near the rail. Scouring could develop into a problem especially just after the weir is installed so also look for developing holes under the rail.

BUOY INSTALLATION

After the weir is installed, buoys are tied off underneath the weir panels to help elevate the floating end. The buoys are located in the attic of the cabin. The easiest way to do this is to have two people grab the end of a panel and lift up while another person goes under the panel and passes the rope through the pickets and back through to tie a quick half-hitch. The buoys are tied off around the third cross member of each panel to prevent slipping.

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It is extremely important to not lift the panels too high because the connector rods and/or the pickets could break. Once the weir is completely installed, any vice grips left on the cable can now be removed and put away.

A CAUTIONARY NOTE

It is important to be cognizant of safety issues. Weir installation can involve difficult tasks done in inclement weather. If someone is not sure of the exact steps necessary to complete a task or if current conditions do not allow them to be done safely, it is best to ask someone with more experience before attempting to accomplish a goal. The weir installation process is progressively more difficult as water levels get higher. At some point (around 2.8 feet on the water level gauge as it is currently set at the weir site) weir installation becomes impossible due to high stream velocities. Even at lower stream levels, visibility can sometimes prevent weir installation.. If moderate or higher water levels are present, four people are necessary to accomplish some of the tasks associated with installation. Typical water temperatures during the normal installation time run about two to four degrees Celsius. Avoid working long hours in the water as fatigue and low body temperatures can contribute to bad decision making and higher accident risks. The application of common sense is necessary to make safe operational decisions.

NELSON RIVER WEIR PANEL ASSEMBLY

Panels are 21 PVC pipes wide

- 5 cross members per panel (UV resistant plastic decking material)
- "A" panels = 36" apart between each cross member
- "B" panels (spray paint end caps orange) = 34" apart between the "hooking end" and 1st cross member, then 36" apart between the rest of the cross members

TOOLS NEEDED FOR WEIR PANEL ASSEMBLY

- 1 1/8" spade bit (for counter sinking holes for eyebolt washers)
- ¾" spade bit (for counter-sinking holes for cross member bolts & washers)
- ¼" drill bit (for all hex head bolts)
- 3/8" drill bits (for eyebolts)
- 7/16" socket head with drill attachment
- 9/16" socket head with socket wrench
- 7/16" open end wrench
- 9/16" open end wrench
- Lots of C-clamps (use bigger ones for clamping the header piece, smaller ones for clamping cross members)

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TOOLS NEEDED FOR WEIR PANEL ASSEMBLY (CONTINUED)

- Cordless drill guns with 18 volt batteries and charger
- Tape measure (for measuring the correct distance between each cross member)
- Hammer

HARDWARE USED FOR WEIR PANEL ASSEMBLY

- 4 ½" hex head bolts (for the hooking end or "header piece")
- 3" hex head bolts (for securing the two cross members together)
- 3 ½" hex head bolts (these were used for pre-assembly layout, not needed for final assembly)
- 7/16" washers and nylox nuts
- 9/16" eyebolts (anchors panels to cable)
- 9/16" washer and nylox nuts
- Aluminum plated "dog ears"
- Black strapping

MAINTENANCE

The weir should be thoroughly cleaned and inspected at least once a day. During high water events it may be necessary to clean the weir more than once due to extra debris buildup. To inspect the weir requires a snorkel mask and dry suit, as not all holes may be visible from the surface. Cleaning the weir requires a brush, used to scrub the panels and remove algae build up. It saves on time and effort if the inspection and cleaning are done at the same time.

During high water events the weir has a tendency to be pushed under water because of the fast current. Extra buoys should be added to weir in order to keep the top above the water. The buoys should be added preemptively, as it is almost impossible to add buoys to the weir when the water is high and fast. If snow melt is on the way, or if it starts to rain heavily, do not wait for the water level to rise before taking action.

REMOVAL

The first task when removing the weir is removal and storage of all buoys. Once completed the gangplank boards and sampling station should be removed and stored. Next all gasket panels should be removed. This will free the trap and livebox for removal.

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Removal of the trap and live box will likely require at least four people, although three strong individuals may be able to accomplish the task with ample time. Fence posts used to anchor the live box should be removed, and the live box detached from the funnel by removing the connecting bolts. Panels should then be removed from the live box by cutting the bailing wire. Panels should be stacked neatly on shore away from the river bank. Sand bags then need to be removed from the live box and funnel. Once the live box and funnel are completely detached and free standing one person should stand at each corner of the funnel. With everyone lifting at once the funnel should be carefully carried to shore. Next the live box should be removed. The live box is very heavy, and the crew should be careful that injury does not occur when moving it. The live box should be carried and set next to the funnel. Fence posts should be driven around the live box and funnel, and everything should be secured together using rope or bailing wire.

The boat should be set up as a platform to stack panels on once they are removed from the cable. All connecting pickets should be removed before anything else happens. Make sure to remove any zip ties or hose clamps that may have been used to patch holes over the season as well. From this point forward there should not be anything attaching the weir panels to each other. They should be attached only to the cable.

The next part proceeds quickly. The cable should be loosened slightly. Starting at whichever end of the river is preferred, one person will stand downstream of the panel, the other upstream. When the signal is given the downstream person will push the panel upstream so that the upstream person has just enough slack to unhook the panel from the cable. This should be one fluid motion. Six to eight panels may be stacked on the boat at a time so that the crew does not have to walk back and forth to remove panels from the water after every unhooking.

The panels should be stacked neatly on shore, away from the river bank in case of flooding. Posts should then be driven in surrounding the panel stacks, and bailing or rope should be used to secure the panels. Remember that the panels are made to float, and any panels not secured properly will end up downriver after winter and spring flooding.

At the end of the season all weir materials should be neatly stacked in an organized manner and thoroughly secured with fence posts, rope, and bailing wire. This will save time at the start of the next season by preventing a hunt for lost weir materials.

INSTALLATION

MATERIALS

All weir installation materials are stacked on the bank of the river at the installation location, about 1½ miles downstream of the cabin. You will need the following items to install the weir and do repairs on the tripods:

- claw (framing) hammer
- 2-3lb hand sledge
- hand saw
- wire cutters
- vice-grips
- 16 penny nails (for attaching sandbag platform boards and catwalk boards)
- 20 penny nails (for stringer supports)
- dock spikes (for reinforcing main tripod timbers)
- a number of 2x4's (for tripod sandbag platform)
- bailing wire
- dry suit, mask and snorkel

LOCATION SELECTION

In 2002, the Sandy River weir was relocated approximately 1 ½ miles downriver from the previous location. The old site was prone to washout during high water and wind events due to the long, straight stretch of river above the weir. The old site also had a very deep channel mid-river which concentrated the force of the river on the weir in that location. The main criteria for selection of the new site were: 1) to find a location below a bend in the river or behind an island which would provide a very short fetch to preempt wave formation and, 2) to find a location with a uniform depth across the river's cross section to mitigate flow concentrations from deep channels. The new site location in 2002 proved successful with little substrate erosion.

The presence of a weir can significantly affect the deposition of river substrate. A trough often forms just upstream of the panels over the course of a summer, and deep channels will form where sections of the weir may have washed out in the past. Over the course of the winter, some of these voids will partially fill with loose and poorly consolidated gravel. If the weir is installed over these areas, the loose fill will once again erode easily and put the integrity of the weir in jeopardy. It is important to recognize these features, as they will have a large impact on how well the installation proceeds and how the weir weathers high, fast water. When preparing to install the weir, it is important to begin by walking transects across the river in the intended location to determine where the most uniform and level substrate is to be found. Moving ten feet up- or down-stream can make a large difference in terms of encountering depressions, gravel bars, or poorly consolidated substrate. Taking a little extra time when selecting the exact location can prevent serious problems later.

Sandy River water levels are generally low in spring when the weir is installed, but can be expected to rise significantly (two feet and more) over the course of the summer. In some years, two distinct

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peaks in water level can be observed which correspond roughly with the peaks in the salmon runs (especially at Bear River). The water can rise as much as two feet in a few hours, usually as a result of heavy rains and/or high winds off the lake and melting glaciers located on volcanoes, so be prepared for the worst early in the season.

TRIPOD PLACEMENT

Place a stake or sandbag on each bank at either end of the chosen transect so that you have a target to work towards and a fixed reference point to sight-off of to check tripod alignment. Begin on the near (northeast) bank with the older, weaker tripods where the current is weaker. Check the 20-penny nails in the front leg of the tripod where the stringers will rest before placing them in the water, as it is hard to drive new ones in place when the leg is underwater. When rolling the tripods down the bank to the river, make every attempt to be gentle so that the timbers do not split or part, and that the nails on the front leg are not bent.

Place the tripods so that the back legs have about four inches of gap between them (the width of your foot) for the shorter tripods and no gap (bottom of the rear legs touch that of the next tripod) for the larger ones. It can aid in tripod alignment if stringers are mounted on the front leg as you work. Make sure there is 6-8 inches of overlap on either end of the stringer where it meets the tripods. Adjust the spacing of the tripods to maintain adequate stringer overlap. Allow more overlap where the current is stronger and the water is deeper. This will allow some tripod settling and traveling without the stringers being pulled off the front leg.

As you work, check the alignment by sighting down the stringers towards the target stake or sandbag on the far bank. The tripods placed in deeper water may require some sandbags to keep them from moving in the current. Because the tripods will float when placed on their side in as little as two feet of water, it helps to roll the tripods upstream some distance and then roll them into the river and float them across the river until you are upstream of the spot where you want to place it. Allow it to float down in the current until it is about ten feet upstream of the desired placement, and then stand it up. Slowly walk it back into position and have someone hold it while others go back to the bank for sandbags to secure it.

Another way to move tripods to the deeper parts of the river is to use the skiff. Place the tripod in the river, facing upstream, near the bank in about two to three feet of water. Walk the skiff under the back wing support (the crosspiece below the wings) until the bow of the skiff is under the tripod's sandbag platform. Roll the tripod back on its back legs until the crown of the tripod is resting on the bottom of the skiff and the main bulk of the tripod is resting on the bow. The wings of the tripod will hang down into the water on either side of the skiff. This is a very effective but precarious way to move tripods as it is easy to swamp the skiff with such a large, unwieldy load. Be sure to load at least ten sandbags in the skiff to secure the tripod once it is unloaded into position. Drive the skiff slowly up behind the position you wish the tripod to occupy, and then further, slightly upstream of the other tripods, before unloading the tripod. You have to drive slowly because the tripod wings are hanging down into the water and any speed will cause these to drag enough to make the tripod slide back in the skiff. As the tripod is tipped upright the front leg will sink down into the water and will contact the river bottom. Slide the wing support

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off the bow of the skiff and have someone immediately step onto the sandbag platform to keep the tripod from shifting until the sandbags are loaded. It is important that the tripod be unloaded upstream of the intended final position because moving the tripod against the current is nearly impossible without loading it back into the skiff and driving it.

Once you have found the correct position for the tripod, push it back and forth forcefully to work the legs down into the gravel and set them in place. This will help minimize movement later. Recheck alignment periodically. Proper alignment of the tripods is critical to having the panels lay flat on the stringers and prevent gaps between panels later. A little extra care and effort at this stage can save countless hours of weir maintenance later in the season when the water level rises.

Once the tripods are set and the stringers are on, spend some time loading the platforms with sandbags as the resistance will increase dramatically once the weir panels are put on. The tripods in the shallow, slow moving water near the banks may need as few as ten sandbags each, while the deeper tripods will require 40 or more. If you begin installing the weir late in the afternoon, this is a good place to stop for the day to allow the tripods to settle down into the substrate overnight before adding the resistance of the panels. This additional resistance can cause the tripods to settle back as well as down, negating much of the effort devoted to alignment.

Keep in mind that the weir generally fails due to sandbags being washed off the tripod platforms, so sandbag placement is critical to surviving episodes of high water. The sandbags should be wedged between the tripod legs as tightly as possible. Eventually, additional sandbags can be stacked on the wings behind the back legs, and a small platform can be added to the crown of the tripod for additional bags. Nail one or two planks across the back of the rear legs above the wing support to keep sandbags from washing off the back of the platform once it is loaded. Sandbags that are underwater are only fractionally as useful as those above the surface of the water as they “lose” much of their weight when submerged, and increase resistance to the water flow. As most of the tripods in the deeper section of the river will have their sandbag platforms well under water during flooding events, stacking as many sandbags as possible on accessory platforms added to the crown of the tripod can mean the difference between washout and surviving the high water event. Use the skiff to shuttle sandbags.

PANEL INSTALLATION

Place the panels on the weir starting on one end making sure that the panels are perfectly perpendicular to the water surface. You will likely have to dig into the substrate to allow the entire bottom of the panel to rest in the gravel as you descend the banks or move past irregularities in the gravel. Hop up and down on the t-angle crosspiece of the panels to push the panel down into the gravel. In the past, longer panels were installed in the deeper, center sections of the river, but a more recent strategy has been to use shorter panels all the way across and allow the river to flow over the tops of the panels during high water events to reduce the resistance. Fish have not been observed escaping over the top of the panels in these instances.

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As you go, do not forget to install the three gates at intervals that cover different water depths. Two gates will be used as fish passes, and one will lead into the sampling trap. As the water level and turbidity rise, you may need to switch to a fish pass gate in shallower water, so install the gates leaving yourself some future options (such as one in moderately deep water, and another closer to the bank). Think about where you want the trap and install a gate for this purpose as well.

Finally, put the catwalk boards on and use them for shuttling more sandbags onto the weir. All boards should overlap on a tripod wing. If necessary, blocks can be nailed to the tripod wings if the catwalk board does not meet the wing properly. During high water events, the catwalk will likely be underwater. The boards wash off easily and so should be removed if their loss seems imminent.

Line the entire front of the weir with sandbags to prevent scouring below the panels. Some have found it more effective to line the backs of the panels with sandbags instead. It may be prudent to experiment with either placement or use both in areas more susceptible to erosion.

Zip ties or bailing wire are used to attach the panels to the stringers and join panels where they meet in order to keep the panels from shifting. While this preempts some minor holes from forming, it also makes it more difficult to push panels down or move them relative to each other when gaps do form. Wiring the panels in the shallow water only could be a safe compromise. Bear activity can also knock panels loose. Zip tying panels to stringers or stacking numerous layers of panels on the weir both help reduce the likelihood of a bear creating a hole.

MAINTENANCE

The weir should be cleaned at least once a day. During high water events it may be necessary to clean the weir more than once a day. Sandy River can have a lot of debris wash down river. If care is not taken to keep the weir clean it will wash out.

Cleaning the weir will usually take two people 20 – 40 minutes depending on how high the water is and the debris load. Dry suits are required to clean the weir, as many very large pieces of turf tend to wash onto the weir due to erosion upstream. It is impossible to get these pieces of turf off the weir without diving. It may also be convenient to carry a rake when cleaning the weir in order to work out rocks and other debris that may be caught in the weir panels.

When cleaning the weir try not to kick up rocks and gravel. The current at Sandy River is fast, any debris kicked up will have to be cleaned later. Generally when moving along the weir it is best to stay on top of the sandbags, or to crawl along the weir panels themselves.

REMOVAL

The weir should be removed in small sections at a time. Starting at the far end of the river, sandbags should be removed from the foot of the weir, followed by panels, stringers, and eventually the sandbags weighing the tripods down. Be sure to leave enough sandbags on the tripod to keep it from floating away. The boat should be used to ferry these items back to shore to be stacked neatly. A separate boat trip should be made for each tripod.

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The tripods should be arranged neatly for easy access during the start of the next season. All items should be stored away from the river bank, as spring flooding and ice may easily carry weir materials downriver if left on the river bank. The ATV and trailer should be used to move tripods and other materials away from the river bank. Take care not to overload the ATV or the trailer.

Once all materials are out of the river and stacked neatly they must be secured. Rope should be used to tightly bind all the tripods together, preventing bears from separating them, and preventing flooding events from carrying single tripods away. The panels should be tied down either with fence posts, ground line, and bailing wire.

INSTALLATION

MATERIALS

All materials for the weir are stacked on either side of the river bank. The materials are divided roughly in half on either bank. You will need the following items to install the weir:

- Post hole driver
- Crisco shortening (non-petroleum based grease) for pushing PVC pipe through rubber straps
- 300 hundred heavy duty zip ties
- Dry suits, gloves, mask, snorkel, and hood
- 2-3lb hand sledge hammer
- Large rubber mallet
- Metal fid to guide pipe through rubber strap
- Barge and hand winch
- 50 Metal fence posts
- Chainsaw winch or hydraulic block

LOCATION

The weir should be installed roughly in the same location as the previous year. The river should be walked in transects a number of times to determine where any holes, sand bars, or channels which could cause problems with scouring or installation might exist. Choose a transect with the smoothest, best consolidated, and most continuously regular substrate possible. Place a stake or sandbag on each bank at either end of the chosen transect so that you have a "target" to work towards and a fixed reference point to "sight" off of to check panel alignment. Keep in mind that the weir should run perpendicular to the river's current in the deepest, fastest channel, which is generally, located closer to the far (south) bank.

It is easiest to begin on the near (north) bank. You will begin by dragging the panels into general position. When dragging panels, fold the foot chain and herring web over onto the panel so that it rests on the PVC, and pull the panel by the second PVC tube from the end, near a hypalon strap. Do not pull on the outermost tube as the tube is weakened by the glue holding the white stopper-rings in place, and may break. Laying the chain on the panel when dragging keeps the chain from being pulled loose from the webbing and keeps the web from separating from the eyelets at the bottom of the panel (the zip-ties break easily). It makes sense to be careful with the panels, as repairing them is extremely laborious and time consuming. If damaged panels are encountered, set them aside and flag the problem spot with surveyor's tape and make the necessary repairs as soon as possible.

There are three different lengths of panels: five, 10, and 15 feet long measured from the herring web to the top caps. The longer panels belong in the deeper water and the shorter in the shallower. Some budgeting of panels will be necessary to have enough long ones, but care must be taken not to put too short a panel in water that may become much deeper on a high tide. As a general rule, the small channel near the near (north) bank requires ten foot panels. Five foot panels are adequate for the entire sand bar which dominates the middle of the river, a number of ten foot panels are needed as the river deepens. Finally, 15 foot panels are necessary to block the deep channel by the far (south) bank.

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The first panel should be laid on the bank so that fish cannot escape around the end of the weir on extremely high tides. Drag a few subsequent panels into their general positions. The weight of the chain may cause it to sink down into the soft sand, making it difficult to move panels when this happens. Either leave the chain lying on the PVC tubes until the panels are in their final positions, or do not leave them unattended for long periods of time in the river; only bring panels out as you need them.

Lay the panels to be joined side by side and line them up so the white, lower end caps of the panels are in line. Pay attention to how the hypalon straps line up as well. The straps from the adjoining panels should not bind or interfere with each other. If they do not lay flat, one next to the other, it will be extremely difficult to drive the connector pipe through them. If necessary, move the panels to be joined relative to each other to see if there is a better orientation for the straps not to interfere with each other, or try to slide the strap up or down its panel slightly. Place a fid in the end of a connector pipe and lubricate the pipe with a thin layer of vegetable shortening. Make sure the connector pipe has a hole drilled through the end with the fid; a zip-tie will later be threaded through this hole to secure the herring web to the bottom of the joint. Carefully push the connector pipe through the available slots in the hypalon straps at either end of the panels to join them. It may become necessary to hammer the connector pipe in with a rubber mallet at the end. The fid fits loosely and it is easy to drop and lose it. It will be necessary to have the person guiding the fid through the hypalon straps float on top of one of the panels as the gap between the panels is too small to stand in as the panels are joined. The fid is sharp and care must be taken so that the person pushing the connector pipe does not accidentally drive the fid against the person guiding it. Good communication is essential here to keep the fid from being lost, and to avoid injury.

After the PVC sections are joined, the herring web must be sewn together with zip-ties. Join the sutured web to the piece of connector pipe via the hole in the bottom of the pipe using a zip-tie. Join the ends of the chain with a 6-8 foot length of light line looped twice through the chains and tied off in an overhand knot. Some sections of chain are considerably longer than the herring web or panels themselves and it may be necessary to "choke up" on the chain, or move back a few links so everything lays flat, without undue gaps, strain, or excess material. Make sure there are no holes in the web where the two sections are joined, or where the web joins the panels or chain through which a small fish could wriggle.

Once two panels are joined, pull the chain as taught as possible along the river bottom and pass a fence post through one loop of the doubled line joining the ends of the chain. Drive the fence post into the river bottom so that the toothed surface faces upstream and the fluke is perpendicular to the current. The entire post should lean upstream at about 30 degrees to resist the current's tendency to pull the panels down river. Drive the post at least three feet down into the sand with a post-pounder.

As you move into the middle of the river it will become necessary to use the hydraulic system, located in the shed, to move panels. Experienced personnel will set up and demonstrate the use of the system to new employees. It may also be necessary to use a pulley set up on the barge to redirect the tension on the rope to keep panels from drifting downstream as they move across the river. The forces exerted by the hydraulic system are large, treat them accordingly.

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As you work into the deeper channel where the current velocity increases, maintaining panel alignment towards the far bank becomes more difficult. It helps to secure the barge in the current with a large anchor placed well upstream and another line running to a deadman upstream on the south bank. In this way you can keep tension across the panels (via the deadman) and keep them from drifting downstream in the current (via the anchor). You will periodically have to move the barge across the river and maintain tension on the installed panels, and to be in an effective position to add subsequent panels. A well thought-out block and tackle system helps enormously to deal with the loads that the current places on the barge when trying to reposition it. Attaching the blocks to the line using prusiks or other "travelling" devices makes the system much more flexible. Having numerous cleats on the barge for a variety of tie-off options is a must.

Once all the panels are installed, crab floats (buoys) will have to be tied behind the panels, below the second hypalon strap down, to keep the top caps of the weir above water. One person can pass the buoy line under the panel while another person is on the panel ready to receive the line and tie it to a PVC pipe below the second hypalon strap with half-hitches (multiple clove-hitches). An alternate and faster way to attach the buoys is to use small plywood discs which the buoy line passes through. Make a 4-6 inch diameter disc and drill a hole in the center to pass the buoy line through. Tie a knot in the end of the line so the disc is not lost. In the river, turn the disc sideways so you can pass it through the panels, between the PVC pipes, from the downstream side, and then allow it to rest flat against the face of the panel. Pull the buoy line through the disc and snug the buoy against the back of the panel, holding it in place with a half-hitch with a bite (which you can untie easily).

The Ilnik Weir is prone to flipping during high tide and wind events. Flip boards should be installed the entire length of the weir to prevent flipping. Fence posts must be driven directly downstream of the weir, across the entire length of the weir. A rope should then be tied to the fence post, run through the weir underneath the second strap from the top, threaded through the eyes on the flip board, and then ran back under the second strap of the panel to be tied off to the next subsequent fence post. The flip board should allow the weir panel to pivot up, but not to move past 70 degrees, restricting its range of motion.

MAINTENANCE

The Ilnik Weir is located close to both the Bering Sea and Ilnik Lake, meaning the weir experiences tidal forces and wave action. If proper precautions are not taken the weir will flip resulting in damage to the weir and gaps. Preventing the weir from flipping during high tides and high wind events is the primary maintenance concern at the Ilnik Weir.

To prevent the weir from flipping, flip boards must be installed as mentioned in the installation section of this appendix above. The fence posts securing the flip boards should be checked daily to make sure they are not being worked out of the sandy substrate of the river bed. If a particularly high tide is forecast, or if the weather is predicted to be extremely windy, extra flip boards should be installed preemptively.

The weir should be cleaned on a daily basis. A dry suit is required for this. All debris must be removed and the chain and gasket at the foot of the weir must be inspected using a mask and snorkel. The deepest section of the weir must be dove upon. It is recommended that two people perform this task, so that one person can hold the other down. It is difficult to inspect the deep channel alone due to the depth; 8-10 feet deep, depending on the tide.

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Both the chain and gasket in the deep channel require constant maintenance. High tides combined with wind and wave action can often work the chain free of its fence post anchors. Once this happens the chain is free to move about during the next high tide event, meaning fish can escape every time the anchor chain lifts off the ground. To prevent this, the anchor fence posts and the rope securing the chain to the anchor fence post need to be inspected daily. If the rope is loose it should be tightened or retied as necessary. It is easier to spend time tightening rope fittings than it is to spend more time and effort later pulling bent fence posts, patching holes, and driving new anchor fence posts.

REMOVAL

The fish trap and sampling station should be removed first. The weir should then be taken apart in sections. It is important not to remove all the pickets and fence posts at once; this will result in a weir that is close to free floating in the river. Weir panels not anchored in the river can be washed downstream resulting in time and effort spent recovering lost floating panels.

Only detach weir panels which will be immediately removed from the river. When the panel is detached the chain should be lifted and laid on top of the panel, this will keep the anchor chain from ripping the gasket. The crab block should be used to pull the panel to shore, with two people escorting the panel to make sure it is not damaged in transit.

Each panel should be thoroughly inspected once it is on shore, and repairs should be made as needed. All weir materials should be secured once on shore in case of flooding; this will save time and effort later.

INSTALLATION

STAGING IN SAND POINT

Things to do:

- Make sure the skiff outboard is running properly. It should be test run in Sand Point. Be familiar with outboard maintenance and operations and take necessary maintenance and repair equipment.
- Buy fuel. Approximately 15 gallons of unleaded and 15 gallons of diesel.
- Take propane. Three 40 lbs bottles should be plenty for the project.
- Buy food. Plan on going without additional supplies until July. There is a propane refrigerator (a little smaller than standard size) which has a small freezer. There is a standard size propane oven in the cabin.

Things to bring:

- Firearms and ammunition
- Radios: VHF base station, hand-held VHF. Test both of these in Sand Point prior to departure.
- Tools
- Float Coats
- Chain Saw
- 12 volt batteries (3)
- Spotting Scope or binoculars
- First Aid Kits
- Each person will need chest waders and rain gear.
- RDA, scale cards, daily weir count forms, logbook.
- Satellite Telephone

SETTING UP CAMP

The Orzinski Lake weir camp is typically set up between June 3 and 7. Camp supplies and personnel will travel to Orzinski Bay in the department aircraft. Low tide will be needed for the beach landing. If the skiff is used, arriving at a high tide is desirable for transporting supplies up the inter-tidal river. If the tide allows, store gear at a location inside the river mouth as it is much more protected and easier to access at low tides. Use the 16-foot flat-bottom Lowe skiff that is stored under the cabin to haul gear upriver to the cabin site. Pull supplies upstream without power until a safe path for jet unit operation can be identified.

INSTALLING THE WEIR

The following procedure is an efficient way to install the Orzinski Lake weir:

- Make 150-180 sand bags from the gravel bar just in front of the weir site.
- Install the tripods in a straight line perpendicular to the water current.
- Initially, place at least 15 sandbags on each tripod.
- Install the stringers
- Install the panels. Panels should be wired to both stringers because of the frequent bear activity on the weir. There are two wooden gates that should be placed in the deep water.
- Line bottom of weir with sandbags. Place sandbags at base of t panels on downstream side of weir.
- Install the catwalk.
- A flash panel should be placed in front of the counting gate.
- A trap for sampling fish should be installed

-continued-

LOGS

Any logs in the lake within 150 meters of the weir should be moved above high water influence. This is much easier than pulling them off the weir when the water rises and will reduce the risk of weir damage during high water events. There are two pee-vees that can be used for this.

MAINTENANCE

The weir should be cleaned on a daily basis. All debris should be kept clear. The foot should be walked and checked for holes daily. Any holes bigger than two inches should be patched.

BEARS

Many bears inhabit the Orzinski Lake area. Bears eventually become accustomed to loud noises or techniques used to deter them from the weir and camp. After the salmon have arrived, personnel should always carry a firearm. Anything left unsecured is subject to destruction by bears. All gear should be safely stowed behind aluminum panels to deter bears from destroying it. Keep the cabin door closed to prevent bears from entering the cabin.

Stay alert when walking from the camp site to the bay. If you stay alert and look around every few minutes you will usually see a bear before it sees you. When returning to the cabin, particularly in the evenings, there will often be bears behind the weir and up against the bank where you cannot see. Make a lot of noise when approaching the weir so bears have time to get out of your way.

REMOVAL

All materials should be stacked neatly in their original location. Everything should be secured against both flooding and bear tampering.

APPENDIX B. GENERAL EQUIPMENT, CAMP MAINTENANCE, AND CAMP POLICY

EQUIPMENT MAINTENANCE

Equipment maintenance is one of the most important operations you will perform during the field season. The outboard motors, generators, and other equipment must be kept in good operating condition.

It will be the crew leader's responsibility to assign the most knowledgeable member of the crew to the job of maintaining and servicing the equipment. It will be this person's responsibility to see that all equipment is kept in operating condition.

ENGINE CARE AND OUTBOARD OPERATION

If an outboard uses mixed fuel, the correct outboard motor fuel mixture is 50:1. The newer Precision Blend outboards mix the two-cycle oil and gas automatically, but older engines will need to have their fuels pre-mixed. Always pour the oil into the tank first, then add 2 or 3 gallons of gas and mix thoroughly, then fill tank to capacity always using a large funnel and chamois filter. Some outboards may be four-stroke engines, which need to have oil level checked routinely. Always mix fuel tanks or equipment under cover to prevent water contamination and always use a funnel and filter. Note that chainsaws have a fuel mixture of 25:1. Chainsaw gas should be mixed in a separate can and clearly marked that it is chainsaw fuel to avoid accidentally being used in outboards.

Always place outboard motors in neutral when starting and always make sure a safety line is attached between the boat and motor. Perform a check daily of the clamp screws that hold the outboard to the transom. Also routinely check the motor for loose screws and bolts, cracks, and breaks, especially in the area of the lower unit. Never start or run an outboard in the tilted position.

In the normal operation of an outboard, a stream of water is discharged from a hole in the bottom edge of the cowling or from the back of the shaft. If this stream of water stops, the water pump may not be working and the motor should be shut off. On propeller outboards, the side plate over the water intake can be removed for cleaning as it may be plugged. If the pump continues not to function, the outboard should not be run, and a report to base camp should be made. On jet units, a cover on the side of the cylinder head through which water circulates can be removed and cleaned, and the cover over the temperature sensor (thermostat) can also be cleaned to restore flow. Take along a piece of bailing wire to dislodge sand from the small water discharge tube under the cowling.

Check the gear oil in the lower unit of the outboard once a week and drain and replace the gear oil at the end of the season and every 50 hours of operation. Jet units must be greased daily. This is crucial. Grease guns will be provided.

If the skeg or jet unit hits bottom, check the screws to make sure they are still secure and there is no damage to the lower unit. Also, remove any rocks stuck between the grates on the jet unit.

All outboards are to be tilted in the up position when moored to preclude silt accumulation in the jet unit or water pump and skeg or housing damage.

If your outboard will not start, check the following:

- Check to make sure the kill switch is clipped to the engine properly.
- Check to see if the fuel line is connected properly to the motor and the tank and not pinched or kinked, and that the air vent on the tank is open.
- Check to see if there is water in the gasoline.
- If the engine is flooded, wait 5 minutes for the plugs to dry before attempting to start again.
- Check the spark plugs and spark plug wires as they may be fouled or defective (replace if needed).

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BOATS

Boats are to be kept clean and free of loose tools and debris, and moored at locations where they are not subject to damage by wave action or through contact with the river bottom in rock laden areas. Boats must be bailed regularly of rainwater to keep them from sinking.

Each crew leader will be responsible for maintaining mooring stakes on the river bank sufficient for the boats assigned to his project plus one transient craft. Further responsibility includes maintaining a bow line on each assigned craft and ensuring that each boat is properly moored at the end of each work day to preclude possible loss or damage.

GENERATORS

Portable generators may be supplied to field camps. Their maintenance is important. Since most of the generators have 4-cycle engines, mixed gas must not be used. The crankcase oil reservoir should be checked daily and maintained at the full level. At the end of the season, and after 25 hours of operation, the oil should be changed. Spark plugs should be checked at every oil change for fouling and gap.

CAMP MAINTENANCE

Maintaining a clean and efficient field camp is required. Maintenance of living accommodations and other installations will be performed as necessary. All materials necessary will be provided.

Grounds will be kept free of litter. All garbage will be bagged up and disposed of at the nearest sanitary landfill at least once a week. Special precautions should be observed to ensure that garbage does not attract bears and other scavenger species.

Upon completion of the summer season, all camp equipment will be cleaned prior to winter storage. All sampling nets, tarps and cloth items must be dry before being stored. All skiffs and ATVs will be chained and locked to a stationary object at the end of the season.

The crew leader at the close of the field season will take a complete equipment inventory. A report detailing the equipment and storage locations will be submitted at the end of the season to the supervisor. A list of equipment needing replacement or repair will also be submitted, along with an equipment need list for next season.

CAMP POLICY

Alcoholic beverages are to be stored out of public view. If alcohol is consumed at a camp an employee must be off-duty and under no circumstances shall he or she engage in the operation of any State equipment or firearms. Employees will not return to duty status under the influence of alcohol.

The crew leader of each camp will establish a policy on living standards and personnel behavior in accordance with State guidelines. Time off for individual crew members must be scheduled by the supervisor. All employees will be required to act in a professional manner at all times and shall be especially courteous to the public. All employees, unless approved by the supervisor, are expected to remain at the camp they are assigned and are not permitted to leave the location.

It will be the responsibility of the crew leader to prevent any abuse of State equipment. The crew leader will report within 24 hours to the supervisor any damaged or lost equipment.

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FOOD ORDERS

Grocery orders should be placed during the evening radio schedule beginning at 7:20 PM. For Nelson, Bear, Sandy, and Ilnik Rivers, the order should be placed with Port Moller, and for Orzinski Lake the order is placed with Sand Points.

PERSONAL GEAR AND PETS

Please limit yourself to 100 lbs. of personal gear. Check with your supervisor first if you anticipate bringing more than that amount to your field camp. Pets are not permitted in remote field camps. Pack in small bags and containers that will easily fit into small aircraft doors.

RADIO OR SATELLITE PHONE SCHEDULES

Radio or satellite phone schedules will be done twice daily to pass on pertinent information to/from the field offices. All employees will participate in these schedules or if an employee is not available the crew leader will pass on pertinent information to the employee. For Port Moller field camps, schedules are normally at 8:20 AM and 7:20 PM on the satellite phones or on the single side band on 3.230 megahertz. The morning schedule is used for passing along the current weather (visibility, ceiling, wind speed and direction, precipitation, etc.) and the previous day's escapement counts. The evening schedule is used for updated escapement counts, grocery, and supply orders, and the latest pertinent fishery announcements. All camps must complete the schedule within 15 minutes in the morning and 30 minutes in the evening, so we do not encroach upon other areas' time allotments. So, keep the conversation short. Personal conversation between camps should be arranged at times as not to interfere with any ADF&G schedules and be kept to a minimum. For satellite phones, a schedule will be worked out with the appropriate supervisory office. Personal use of satellite phones will be limited to a specific time that will not interfere with any radio schedules, and only be allowed if there is no cost to the state. **Emergency contact phone numbers should be clearly displayed on/near the phone and radios in the cabin.**

If a camp does not respond to two consecutive radio/phone schedules, a plane will be dispatched to check on employees. If you know that you will not be able to make a radio schedule, notify your supervisor in Sand Point or Port Moller. If you miss a morning radio schedule without prior arrangement from your supervisor, you must immediately contact your supervisor to pass on pertinent escapement numbers which are used for management of the fishery as well as passed on to other locations. In an emergency, the Coast Guard can also be summoned using frequency 4.125 MHz by saying "Mayday, Mayday, Mayday" and give your name, say who you work for, your location (field camp name on the Alaska Peninsula and approximate distance from a town, i.e. 10 miles east of Port Moller for Bear Lake or lat. /longs. if known), and the nature of the injury or emergency. Always broadcast even if you think nobody hears you. Somebody may be listening to the radio somewhere and can pass on your emergency to the appropriate people. All personnel need to be familiar with the single sideband/phone and the operation to contact the appropriate emergency personnel. A list of sideband frequencies and phone numbers should be readily available (taped to the radio/phone) if an emergency exists. If 4.125 MHz on the single side band radio is not marked on the radio and you need assistance finding which dial number it is located on, please ask the appropriate supervisor. Listed below is the latitude and longitude of some field camps. These lat./longs. should be written on the radio or be readily accessible in an emergency.

Orzinski Lake, ADF&G cabin	lat. 55°43′783″ N., long. 160°05′700″ W.
Nelson River ADF&G cabin	lat. 55°48′990″ N., long. 161°14′047″ W.
Bear River ADF&G cabin	lat. 56°02′242″ N., long. 160°16′098″ W.
Sandy River ADF&G cabin	lat. 56°11′941″ N., long. 160°01′529″ W.
Ilnik River ADF&G cabin	lat. 56°36′729″ N., long. 159°34′282″ W.
Port Moller Airstrip	lat. 56°00′331″ N., long. 160°33′665″ W.

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All North Peninsula field camps will standby on channel 72 and Orzinski Lake on channel 6, as do local pilots and commercial fishermen. All employees should be aware of the gear in the back pack and should request additional safety/survival items if needed or missing. Employees with any questions or concerns are asked to pass them on to their supervisor.

FISH AND WILDLIFE VIOLATIONS

This is not intended as an inclusive procedure for handling violations. Below are guidelines for obtaining the necessary information and/or evidence to document a violation. It is important to be familiar with the commercial fishing, subsistence fishing, sport fishing, and hunting regulations in your area. Violation reporting procedures are printed on the back cover of the commercial fishing regulation book. Request the regulation book if your camp does not have one.

The use of the "4 W's" can greatly aid the Fish & Wildlife Protection officer in obtaining sufficient evidence for a case.

- What is the violation?
- When did the violation occur (e.g. date, time, tide condition, etc.)
- Where did the violation occur?
- Who is in violation and who are witnesses?

It is important that specifics about the event be documented so the appropriate officer can follow-up and contact those involved. If you have a camera available, pictures are extremely valuable in prosecuting offenders. Collect as much information as possible and contact your supervisor or a State Trooper from the Fish and Wildlife Protection Division immediately. If you do not feel comfortable, or your personal safety may be in danger, do not pursue the violation. Contact your supervisor and they will handle the situation. Be aware that you do not have the power to arrest somebody or seize equipment. Just limit yourself to documenting the event as safely as possible.

FIREARMS

A State weapon will be provided at each camp. If you are unfamiliar with the operation and use of a firearm, please let your supervisor know. Training will be provided for anyone who requests it or is unfamiliar with firearms. Loaded guns are prohibited inside the camp facilities. Anyone handling a firearm should always treat it as if it were loaded. Guns should be kept clean and oiled and be completely unloaded while being cleaned. Any horseplay or misuse of firearms while working for the Department of Fish and Game will not be tolerated and may be grounds for immediate dismissal. Completely unload a firearm of all rounds before entering a vessel, airplane, or four wheeler.

BEARS

Do not encourage bears to come around camp by leaving food or unburned garbage around. Do not shoot at a bear unless, in your best judgment, it is endangering someone's life or damaging personal or state property. Use your best judgment on whether to shoot a bear if property is at stake. When trying to frighten a bear away by shooting, do not fire toward it. You may wound it by pulling the shot, ricochets, etc. Do not use cracker shells at close distance (<30'). If a cracker shell hits a bear at close range, it may penetrate the body cavity and explode inside the bear, killing it. If you are having problems with a particular bear around camp, call the appropriate supervisory office and notify them of the situation. The Division of Wildlife Conservation personnel may take care of the problem.

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GARBAGE

Burn garbage as needed to prevent bear problems (e.g. food products). A burn barrel should be used to ensure that any bear attractants are completely incinerated. If a burn barrel is not available make sure the fire burns hot enough to incinerate food. Flatten metal cans and box them for empty return flights. Be sure all burn barrels have proper grates or covers to prevent grass fires from sparks. Never leave a fire unattended and always have adequate fire extinguishing materials handy.

TRANSPORTATION

Do not endanger life or property by going out in a boat on dangerously rough water. If you are unfamiliar with marine safety, ask one of the field offices for information or advice. All personnel must wear a Coast Guard approved life jacket when out on any water. Be conservative and use good judgment; if you think it is dangerous, don't go out on the water.

Extra shear pins or propellers, and a tool kit which includes pliers, spark plugs, and a spark plug wrench, should be in the boat at all times. Also, handheld VHF and flares should also be carried. In case travel at night becomes necessary, carry a flashlight.

Some camps may be furnished with 4-wheel all terrain vehicles (ATV). The following safety precautions shall be observed at all times regarding Department ATV operation. Follow all safety rules listed on the vehicle and in the safety manual provided by the manufacturer. If the manual is unavailable, contact your supervisor, as they will have a copy that could be sent to you. A safety helmet is provided. An ATV may provide transport of State materials, supplies, and equipment between camp sites and supply planes or vessels. In addition, they may be used for transportation to and from assigned duties in the field such as monitoring a fishery or collecting harvest information, etc.

Review the Marine Safety and Light Aircraft Safety Manuals located at all camps before boating or flying. Do not get in a boat or plane if you feel uncomfortable with the situation. Consult the crew leader or pilot beforehand.

FIRE AND FIRST AID

All remote employees are required to have up to date 1st Aid and CPR certificates. Make an effort to avoid intestinal parasites such as *Giardia*. When in doubt, boil your drinking water for 15 minutes.

Check your camp's fire extinguisher. Know where it is and how to use it! Inventory your camp first aid kit, replace items as needed and become familiar with basic first aid treatment.

Keep the cabin, surrounding area, and yourself clean and neat. Appearance is important. You will not always be notified of the intended arrival of visitors, officials, etc. Visitor impressions are often based on your appearance.

COMPATIBILITY OF FIELD PERSONNEL

Field work involves close contact with few people for extended periods of time. Every effort should be made to get along well and maintain positive relationships with co-workers. Employees should make genuine efforts to be cleaner, more courteous, and forgiving of their co-workers than would be necessary in normal 9 AM–5 PM working conditions. A genuine effort should be made to resolve any disagreements that arise. If your camp mates are doing something that irritates you, talk to them about it politely, chances are they are unaware that they are causing a problem for you. If you find yourself absolutely unable to get along with other members at your camp despite your best efforts, notify your supervisor and an attempt will be made to resolve the situation.

APPENDIX C. KEY TO FIELD IDENTIFICATION OF ANADROMOUS JUVENILE SALMONIDS IN THE PACIFIC NORTHWEST

Key to Field Identification of Anadromous Juvenile Salmonids in the Pacific Northwest

By

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ABSTRACT

A key is presented with descriptive illustrations to help in field identification of live, juvenile salmonids in fresh waters of the Pacific Northwest. Other juvenile fish that may be mistakenly identified as salmonids are included.

INTRODUCTION

Species identification of live, anadromous juvenile salmonids is frequently a problem to the field biologist. The purpose of this key is to list and illustrate the external characteristics which will expedite field identification of juvenile salmonids in the Pacific Northwest.

Five species of Pacific salmon (pink, chum, sockeye, chinook, and coho); four species of trout (cutthroat, brown, Dolly Varden, and rainbow or steelhead); and other juvenile and adult fish [1] that may be mistaken for salmon or trout in fresh water are described in this key.

USE OF KEY

The characteristics for identification are listed in a series of alternative statements, some of which are illustrated. To use the key, examine the first statement; if applicable, proceed to the next and continue to successive statements until the species is identified. If a statement is not applicable, pass to the alternative characteristics indicated by numbers in parentheses (numbers on the drawings correspond to numbers of statements in the key). Continue in this manner until the specimen is identified. Some external characteristics are positive separating features (marked with asterisk), whereas others are not. Therefore, two or more statements should be considered before final rejection. If a precise identification cannot be made using the external characteristics —and the fish can be sacrificed, a positive identification can usually be made from internal features (marked with double asterisks). A bibliography of keys that utilize more descriptive internal characteristics is included in this paper.

[1] Especially adult smelt, family Osmeridae.

KEY

1. (47) Adipose fin and scales present. (Fig. 1)
2. (48) Fleshy appendage at base of pelvic fins present.
3. (49) Mouth large, reaching at least to center of eye.

Family Salmonidae

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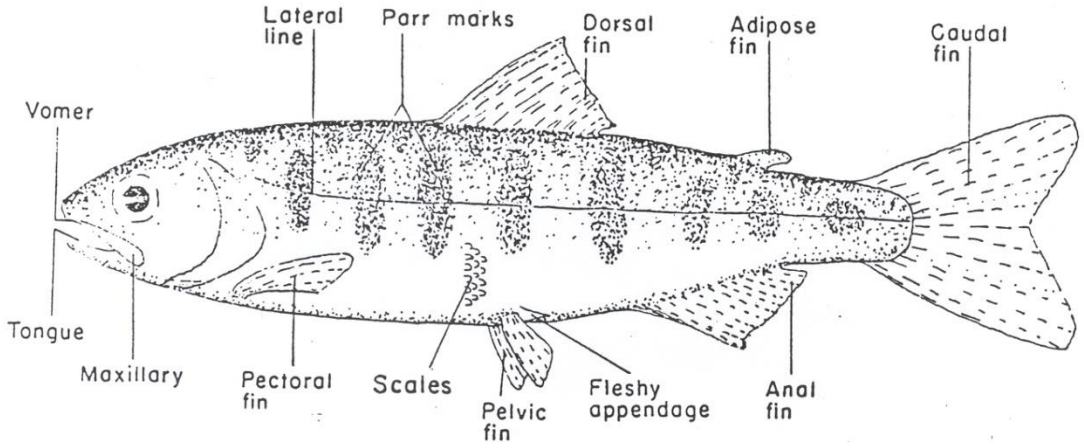

Figure 1.—A hypothetical salmonid showing external characteristics.

4. (17) Anal fin higher than long, with 8 to 12 developed rays (Fig. 2A)
5. (52) *Teeth on head and shaft of vomer. (Fig. 3A)

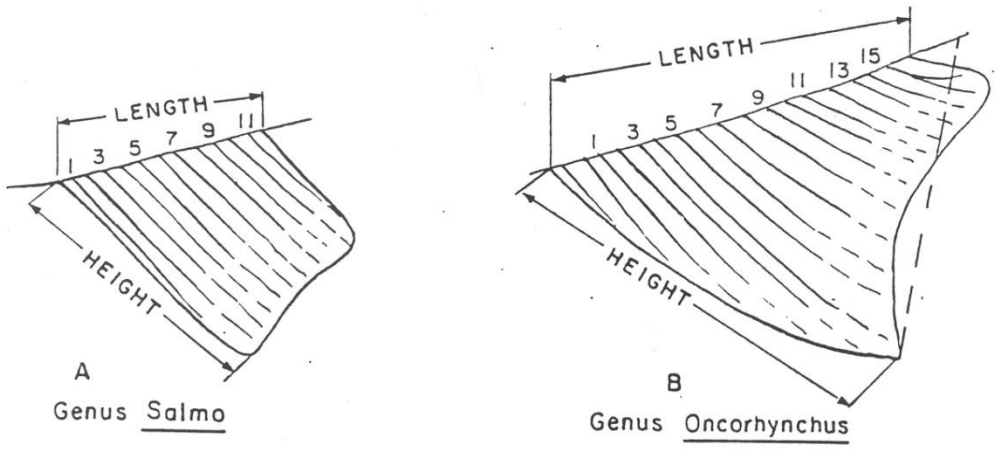

Figure 2.—Anal fins: (A) Trout, genus *Salmo;* (B) Pacific salmon, genus *Oncorhynchus.* The two drawings show differences in structure and fin ray count. (Note that the length of the anal fin is its overall basal length, and its height is that distance from the origin of the fin to the tip of the anterior lobe. In counting fin rays, include only those which originate from the base and terminate at the outer margin of the fin or are half as long as [or greater than] the longest ray.)

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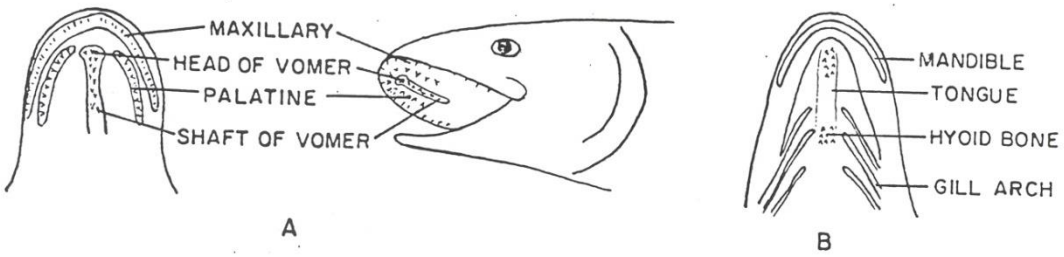
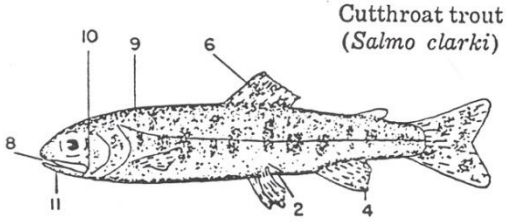


Figure 3.—Location of dentition in (A) the roof and (B) the floor of the mouth of salmonid fishes. (Presence or absence of teeth on the vomer or tongue may be determined by use of the little finger or a blunt instrument. The small hyoid teeth at the base of the tongue are located between the gill arches of the lower jaw and are difficult to find.)

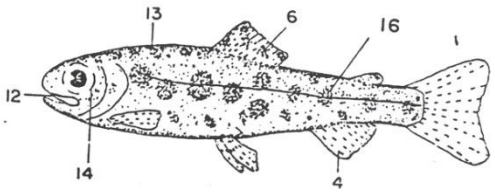
6. (18) Dorsal fin with large dark spots.
Trout
Genus *Salmo*

7. (53) Adipose fin not orange; no row of pale round spots along lateral line.
8. (12) *Small hyoid teeth at base of tongue. (Fig. 3B)
9. (13) Not more than five parr marks on mid-dorsal ahead of dorsal fin.
10. (14) Maxillary reaching past posterior margin of eye.
11. (15) Red or yellowish hyoid mark under lower jaw. Tail usually black spotted.
Cutthroat trout
(*Salmo clarki*)



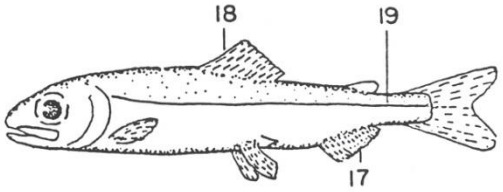
12. (8) *No teeth at base of tongue.
13. (9) Five to 10 parr marks along mid-dorsal ridge ahead of dorsal fin.
14. (10) Maxillary short, not reaching past posterior margin of eye.
15. (11) No hyoid mark under lower jaw. Few or no spots on tail.

16. (20) Parr marks almost round.
Rainbow or
steelhead trout
(*Salmo gairdneri*)



17. (4) Anal fin longer than high, with 13 or more developed rays. (Fig. 2B)
18. (6) Dorsal fin without large dark spots, may be black tipped.
Pacific salmon
Genus *Oncorhynchus*

19. (20) No parr marks. Fry leave fresh water while small—approximately 1.75 inches (45 mm) long.
Pink salmon
(*O. gorbuscha*)



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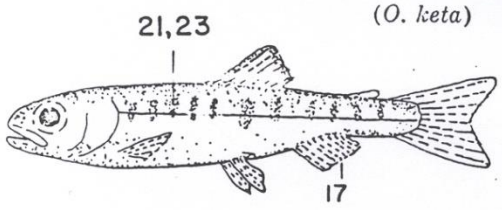
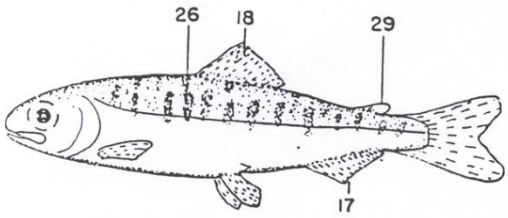
20. (16) Parr marks present as vertical bars or oval spots.
21. (30) Parr marks short, extending little, if any, below lateral line.
22. (25) Gill rakers on first arch, 19 to 26. ** Pyloric caeca, 140 to 186.
23. (26) Parr marks faint. Sides below lateral line iridescent green.
24. (27) Small when migrating from fresh water, approximately 1.5 inches (40 mm) long.

Chum salmon
(*O. keta*)



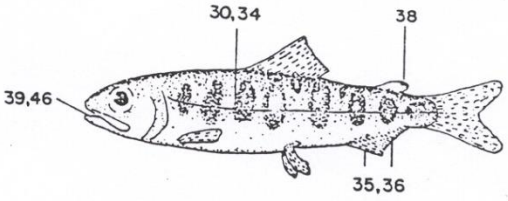
25. (22) Gill rakers on first arch, 30 to 40. **Pyloric caeca 60 to 115.
26. (23) Parr marks usually sharply defined. Sides below lateral line silvery, not iridescent green.
27. (24) Relatively large when migrating from fresh water, approximately 3 to 5 inches (80 to 126 mm) long.
28. (31) Gill rakers long and slender, more than 29 on first arch.
29. (32) Adipose fin clear, not pigmented.

Sockeye salmon
(*O. nerka*)



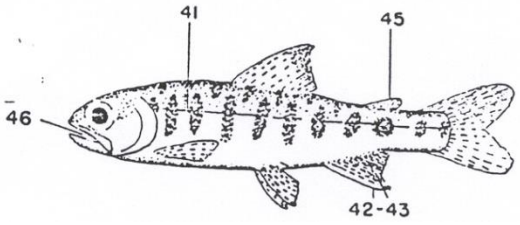
30. (21) Parr marks large, vertical bars centered by lateral line.
31. (28) **Gill rakers short and thick, fewer than 29 on first arch.
32. (29) Adipose fin at least partially pigmented.
33. (40) **Plyloric caeca more than 90.
34. (41) Parr marks broader than interspaces.
35. (42) Anterior rays of anal fin not distinctly longer than rest, not white edged.
36. (43) Anal fin not pigmented.
37. (44) Black spots, when present, on both lobes of caudal fin.
38. (45) Adipose fin not completely mottled, clear area at anterior base of fin.
39. (46) Black gums along base of lower teeth.

Chinook salmon
(*O. tshawytscha*)



40. (33) **Plyloric caeca less than 80.
41. (34) Parr marks narrower than interspaces.
42. (35) Anterior rays of anal fin elongated; when depressed they extend to base of last ray. (Fig. 2B)
43. (36) Anal fin pigmented between rays, resulting in black banding.
44. (37) Black spots, when present, on upper lobe of caudal.
45. (38) Adipose fin completely pigmented.
46. (36) Mouth gray to white.

Coho salmon
(*O. kisutch*)



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47. (1) Adipose fin not present; scales present or lacking.

Not Salmonidae

48. (2) No fleshy appendage at base of pelvic fins.

Smelts
Family Osmeridae

49. (3) Mouth small, not reaching center of eye; teeth weak or absent.

50. (51) Depressed dorsal fin, shorter than head.

Whitefishes
Genus *Coregonus*

51. (50) Depressed dorsal fin, longer than head.

Arctic grayling
(*Thymallus arcticus*)

52. (5) **Teeth on head of vomer only.

Chars
Genus *Salvelinus*
Dolly Varden (*S. malma*)

53. (7) Adipose fin orange; row of distinct pale round spots along lateral line.

Brown trout
(*Salmo trutta*)

ACKNOWLEDGMENTS

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